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VIRGINIA
DEPARTMENT OF AGRICULTURE
ANNUAL REPORT 1906
GEO. W. KOINER, COMMISSIONER.

THE HERMITAGE PRESS, INC.

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G. W. KOINER,

Commissioner of Agriculture.

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UNIV.

A VIRGINIA WHEAT FIELD.

Made an Average of Forty Bushels Per Acre from 100 Acres—Buckingham

DEPARTMENT OF

Agriculture and Immigration

OF

VIRGINIA

ANNUAL REPORT, 1906.

G. W. KOINER, Commissioner.

RICHMOND:
THE HERMITAGE PRESS, INC.
1907

DEPARTMENT OF

Agriculture and Immigration of the State of Virginia.

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Chief Chemist	E. W. MAGRUDER.
Assistant Chemist	C. M. BRADBURY.
Chemist	J. B. ROBB.
Chemist	H. L. DAVIDSON.
Chemist	J. H. PARKINS.
Pure Food Inspector	JOHN A. STUART.
Messenger	F. WALKER.

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First District	E. I. NOCK.
Second District	E. C. MADISON.
Third District	J. A. LESTER.
Fourth District	L. D. JONES.
Fifth District	A. L. MOORE.
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REPORT

OF THE

President of the State Board of Agriculture and Immigration

To His Excellency, CLAUDE A. SWANSON, *Governor of Virginia.*

SIR,—On behalf of the State Board of Agriculture and Immigration it gives me pleasure to state that the work of the Department is making substantial progress. The meetings of the Board have been well attended and the deliberations of the body have been harmonious.

The Legislature at its last session made an appropriation for immigration work. The Board sent its worthy Commissioner to Europe to look over the field and to study the situations and report. The Board is unanimously of the opinion that nothing but farm labor from the rural districts is desired in Virginia. For further information on this subject I respectfully call your attention to the report of the Commissioner of Agriculture and Immigration. The Farmers' Institutes have been well attended by the people. We hope to be able to broaden this work and make it more effectual than it has been in the past.

Jamestown Exposition.—It gives me pleasure to state to your Excellency the Board appropriated three thousand dollars, and in addition to this amount gave the service of their ten inspectors for half a month each to assist in making collections for the exhibition, which service has been rendered.

The Board has about completed arrangements whereby a station in the trucking section will be established. This station will be known as the Virginia Trucking Experiment Station. It will be located near Norfolk in the trucking section. After it is established by the State Board of Agriculture it will be put under the control of a governing board composed of two representatives of the Truck Growers of Virginia. two from the Department of Agriculture of Virginia and two from the

Virginia Agriculture Experiment Station. One of the coöperators in this work will be the Department of Agriculture of the United States.

In conclusion it gives me pleasure to testify to the faithful, energetic and efficient services of the Commissioner of Agriculture as the executive officer of this Board; also to a like satisfactory service of all the officers and employees of the Department.

For the details of the work of the Department and a financial exhibit of its receipts and expenditures, I respectfully call your attention to the report of the Commissioner herewith submitted, in connection with a report from the Chief Chemist.

Respectfully submitted.

C. W. HEATER,

President of State Board of

Agriculture and Immigration of Virginia.

ANNUAL REPORT

OF THE

Commissioner of Agriculture and Immigration.

Honorable Claude A. Swanson, *Governor of Virginia.*

Sir,—I beg to submit herewith the twenty-eighth annual report of the Department of Agriculture and Immigration.

The State makes no appropriation for the support of this Department. The small tax of fifteen cents per ton as an inspection fee on the sale of fertilizers in this State is the only income. A close supervision over the sale of fertilizers has been made and samples from 1,200 brands have been drawn by the inspectors in the different sections of the State. Samples from all brands have been analyzed and published in bulletins quarterly and mailed to 32,000 farmers whose names have been secured on the mailing list. The protection this fertilizer law gives to the farmers saves more money each year, from adulterated stuff, than the amount they pay for their State and county taxes. These bulletins give to the farmer the true contents of the fertilizer and also the relative commercial value per ton, so that he may not pay more than the value of it.

Our farmers have been liberally supplied with information by bulletins and annual reports. The following bulletins, in addition to the annual reports, are mailed free of cost to any farmer or investor: Bulletins on Fruit Growing in Virginia, Cattle Raising in Virginia, Horse and Mule Raising in Virginia, Sheep Raising in Virginia, Poultry Raising in Virginia, Corn Growing in Virginia, Lead and Zinc Deposits in Virginia, The Water Power in Virginia. Nearly two hundred thousand bulletins have been sent out to our farmers this year. The demand for printed information by our farmers is increasing from year to year. They are having more faith in scientific agriculture. They are using more brain with brawn, which goes to make a good farmer, and good farmers are the best assets a State can have. The products of Virginia farms are now worth seventy-million dollars per year, and Virginia is the wealthiest State in the South except Texas. The soil is the basis for all wealth and prosperity. Our farmers are giving more attention to improving their land; more cow peas and other nitrogen-gathering and humus-making plants are grown now than in former years. More labor-saving machinery is used; the hay crop has doubled in ten years, and more live stock is kept. One-third of our farmers derive their principal income from live stock. Trucking in Virginia has increased nearly five hundred per cent. within the last ten years. The caning industry in one county last year reached $800,000. The peanut crop of this State is much larger now than was the entire crop in the United States a few years past. More fruit trees have been set within the past five years than in the past twenty-five years. Many farmers are offering a part of their land for sale and farming better on a smaller acreage. The average size of Virginia farms has decreased in the past twenty-five years from four hundred to less than two hundred acres, and the number of farms has increased from seventy-five thousand to one hundred and sixty thousand. The value of our land is increasing from year to year. In some sections of the State land has increased from fifty to one hundred per cent. within a few years.

IMMIGRATION.

The greatest drawback to agriculture in this State now is the scarcity of farm labor. Many farmers have been compelled to greatly reduce their farming operations on this account. Virginia does not grow enough wheat, hay, hogs and dairy products for home consumption. One-half of the farmers in the State want more labor—that is to say, fifty thousand farmers want labor. Many farmers this year have suffered heavy loss and inconvenience for the want of labor to harvest and store their crops at the proper time.

The last Legislature made an appropriation of $10,000 to be used to induce farm labor, farm tenants and homeseekers to come to Virginia.

Your Commissioner was sent to Great Britian and Northern Europe to look over the field and begin this important work. This was the first effort ever made to advertise this State in foreign countries. For twenty years the Western railroads have been seeking immigrants in foreign fields and reports had been made warning immigrants against the South. "They said the South was overrun with negroes; that immigrants would be required to eat and associate with them; that the South was extremely hot and full of deadly fevers and that the white people were but little better than the negroes." Such falsehoods had been circulated for years and no official from Virginia had ever denied them. It will require time to remove such false impressions. Agents have been employed in the different countries and some good immigrants have already come to Virginia, and many more will arrive during the winter and coming spring. This work had to begin at the ground and must be gradually built up with desirable people only. Our people would rather have the first year a few hundred honest, industrious, faithful, law-abiding farm laborers and homeseekers than thousands of idle, worthless, unemployed and unemployable people who will not work at home or abroad.

A proposition was made to me to supply Virginia with 2,000 immigrants free of cost to the State, but knowing the countries these people were to come from I declined the offer, believing that our Virginia people did not want them.

The farm labor our agents abroad are instructed to seek is intelligent, honest and faithful; they are trained to do their work right and take an interest in their employer's business, and one of them is worth more to the farmer than two or three of the common negro laborer. If we begin this work with the best class of farm labor the same kind will follow their friends, and the first immigrants who come, if well located and well treated, will make the best advertisers the State can have, hence especial effort is being made to have them located well, for each immigrant, if he is pleased with his new home, will induce a dozen of his friends to follow within the next year, and they in turn will bring others, and in a few years we will have a supply of the best class of foreign labor. We have now agents in Great Britain and in Northern Europe who are instructed to send only good people who want to work on the farm and better their condition in life. I believe this movement will be successful; but it cannot be done in a year, but when the industrious, hard-working farm tenants in Europe, who are paying now from $5.00 to $40.00 an acre money rent each year, learn that good land can be bought in Virginia for the same money, they will come to this State in such numbers that every farm for sale will find a buyer and every idle acre will be in cultivation. All of this will greatly enhance the value of all Virginia lands.

There is keen competition in the best foreign fields for immigrants. Besides many of the States have made large appropriations. Canada has appropriated five millions of dollars and has more than three hundred agents now at work in Great Britain, offering one hundred and sixty acres of land and free passage. Africa, Australia and New Zealand are also in the field; but none of these or any other State has the superb climate, nearness to market and kind soil that grows all crops equal to Virginia.

A new hand book has been published and is being distributed in other States and in Great Britian, Germany, Norway, Sweden and Denmark, giving a clear and comprehensive description of the entire State and also a write-up of each county and city, with illustrations.

INSTITUTES.

Farmers' institutes have been held in all the congressional districts, conducted by the member of the Board of Agriculture for his district. Our farmers greatly appreciated them.

A farmers' institute, tobacco, alfalfa and corn-breeding train was run over a thousand miles of track, stopping at frequent places, where thirty-minutes lectures were delivered by experts on the above named crops. More than eight thousand farmers listened to these lectures. This was the first institute train ever run in the South. Other similar trains will be run again. The Southern and the Norfolk and Western Railroad companies very magnanimously furnished and operated these trains free of cost to the Department of Agriculture. Our thanks are tendered to Mr. M. V. Richards, of the Southern, and Mr. F. H. LaBaume, of the Norfolk and Western, for their efficient services in securing these trains for such purposes.

PURE FOOD.

A second food bulletin has been issued this year, giving the analysis of foods, feed, etc. An inspector is kept in the field constantly drawing samples and watching that the law is not violated and the people protected from injurious adulterations and that all food and feed is properly labeled.

There are now five chemists keep busy in the Laboratory of the Department analyzing fertilizer and food samples.

The Legislature made a liberal appropriation for the establishment of an agricultural museum in the old hall of the House of Delegates, under the supervision of a commission composed of Senators A. R. Hobbs and H. O. Kerns, Delegates A. M. Bowman and W. W. Baker, and the Commissioner of Agriculture. This work is now nearing completion and is greatly admired by our people. It makes a good impression upon visitors and homeseekers, and will prove to be a valuable advertiser of the State's resources and add to the prominence and usefulness of the Department of Agriculture.

The work of the Department has steadily increased from year to year and the clerks and chemists are kept busy doing work daily, long after office hours. A financial statement is herewith submitted, also a report from the Chief Chemist.

Respectfully submitted.

G. W. KOINER,

Commissioner of Agriculture and Immigration.

DIVISION OF CHEMISTRY.

REPORT OF THE CHIEF CHEMIST.

Hon. G. W. Koiner, *Commissioner of Agriculture and Immigration.*

Sir,—During the past year the fertilizer and miscellaneous work of this Department has largely increased. The increase has been so great that another assistant chemist became necessary, and Mr. H. L. Davidson, of Blacksburg, was gotten in February to fill the position. Mr. Davidson has the degree of Bachelor of Science and Master of Science of the Virginia Polytechnic Institute, and was assistant and instructor in the same institution for about three years and a half.

The Legislature at its last session increased the appropriation for food work, and in order to better carry out the provisions of the law Mr. A. C. Rucker, of Roanoke, was appointed Food Inspector, and Mr. J. H. Parkins, of Augusta county, was appointed Assistant Food Chemist. Mr. Parkins is a graduate in the full chemical course of the University of Virginia, and was Assistant Chemist at the State College of Pennsylvania.

WORK OF THE YEAR.

The following is a summary of the work done in the Laboratory. The number of samples of fertilizer analyzed is the work of the year in that line, while the rest of the analytical work is that done from November 10, 1905, to October 1, 1906:

Fertilizer samples analyzed	1,224
Food samples analyzed	681
Mineral and miscellaneous samples analyzed or examined	335
Total	2,240

These are classified as follows:

Fertilizers collected by inspectors	1,163
Fertilizers sent in by farmers	61

FOODS.

Baking powder	38
Canned Asparagus	13
“ Baked Beans	27
“ Cherries	12
“ Corn	12
“ Okra	8
“ Peaches	15
“ Pumpkin	5
“ Tomatoes	16
“ Succotash	6
Cider	14
Catsup	43
Jams	40
Jellies	32
Lard	7
Molasses and syrup	80
Mustard	32
Olive Oil	5
Pepper	54
Pickle	7
Sauce	19
Stock Feed	135
Sugar	7
Vinegar	48
Miscellaneous	6

MINERALS.

Ashes	4
Clay	31
Copper	4
Gold	5
Granite and Gneiss	12
Graphite	4
Hornblend	6
Iron Ore	19
Kaolin	4
Lead Ore	8
Limestone and Marl	54
Mica	19
Manganese Ore	13
Pyrites, Iron	25
Quartz and Sand	28
Sandstone	9
Silicious Minerals	19
Slate	21
Titanium Ores	4
Water	15
Zinc Ores	2
Miscellaneous samples	29

FERTILIZERS.

There were 1,913 brands of fertilizer registered during the year, an increase of 141 over last year. I had hoped several years ago that this senseless multiplication of names was about at an end, but I find that I was very greatly mistaken, for there has been a steady increase of names each year since. The farmers and fertilizer agents are much more to blame for this than the manufacturer, for the latter, in most cases, would gladly reduce the number of brands. If the farmer would buy more by the composition and less by the brand, he would be very much better off. Most fertilizer manufacturers have anywhere from two to a dozen, or more, brands of fertilizer with the same guarantee. Now, as a rule, each one of these manufacturers fill the bags, on which are stamped all of these different brands, from identically the same pile of fertilizer. Therefore, why should a farmer care which one of these brands—all with the same guarantee—he got from any special manufacturer, and why should he give two or three dollars more for a certain brand than for another taken out of the same pile, which he frequently does?

I do not mean to say that fertilizers of the same guarantee made by different manufacturers are all of the same crop-producing value; for one manufacturer may use better material or mix better or have the fertilizer in better mechanical condition, or have it more uniformly come up to or go above guarantee than another. All or any of these qualities will cause the fertilizer possessing them to produce the best crops. But I do say, that any two fertilizers of the *same composition,* made from the same materials, in the same proportion, equally well mixed, and in equally good mechanical condition, will give the *same results,* no matter by *whom made* or under what *brand-name sold.* Therefore, either mix your fertilizer yourself or buy from a reliable manufacturer by the *composition* and not by the *brand.*

QUALITY OF THE FERTILIZERS.

The following table gives a comparison of the fertilizers for the past five years:

FERTILIZER FALLING.	1902	1903	1904	1905	1906
Below guarantee	11.55	10.70	19.10	13.49	21.11
10 per cent. below guarantee	.84	1.99	1.91	2.09	4.37
Below guarantee in phosphoric acid	4.21	6.55	8.95	9.76	16.08
10 per cent. below guarantee in phosphoric acid	.38	1.24	1.51	2.86	3.09
Below guarantee in ammonia	42.81	31.03	51.00	35.54	41.70
10 per cent. below guarantee in ammonia	25.18	9.83	26.75	14.59	17.27
Below guarantee in potash	31.65	29.57	35.82	25.50	27.79
10 per cent. below guarantee in potash	17.87	13.42	19.18	4.39	10.74

From an examination of the foregoing table it is readily seen that the fertilizers made a bad showing, the worst in the past five years. The number falling below guarantee and ten per cent. below guarantee, both in the individual ingredients and in the sum total of these ingredients is entirely too large.

The farmers should study the bulletins more and see just what fertilizers fall below and which manufacturers put up fertilizer which falls most below and most often below, and avoid those brands and manufacturers and buy only from those manufacturers who put up the best goods, or what is better still, buy the ingredients and mix their own fertilizers.

Farmers can buy the ingredients and mix their own fertilizers and save anywhere from two to ten dollars by the operation. Then, too, they will know what they are getting.

PURE FOODS.

The second food bulletin (Bulletin No. 30) was published during the summer, giving the law, standards and rulings in full, together with the results of the analysis of 393 food samples.

In the following table is given a summary of the results of the food examination:

NAME OF ARTICLE EXAMINED.	Number of Samples Examined.	No. samples found either below standard, adulterated or containing an injurious metal.
Baking Powder	42	25
Canned Apples	2	2
" Asparagus	10	10
" Baked Beans	20	20
" Peaches	30	30
" Pears	9	9
Catsup, Tomato	36	35
Jams	33	26
Jellies	24	17
Pepper	22	12
Sauces	17	6
Stock Feeds	110	12
Vinegar	38	18
Total	393	222

It is readily seen from this table that the foods made a bad showing, as 56.5 per cent. were not as they should be. Last year 48.6 per cent. of the samples examined were not as they should be, but the larger per cent. found adulterated this year is no indication that foods are being adulterated to a greater extent now than last year, for different kinds of goods were examined this year, and the kinds examined were those more likely to be adulterated, and in the few cases in which the same kinds of goods were examined the brands were, in most cases, different from last year, so that it is not correct to compare the percentage of adulteration found this year with that of last year. With the additional appropriation made by the last Legislature for food work, many more samples are being, and will be, analyzed than in the past, but it will require a much larger appropriation still in order that a thorough and complete examination of foods may be made, such as the great importance of the subject justifies and demands.

DISSEMINATION OF THE RESULTS OF ANALYSIS.

Four fertilizer bulletins and one food bulletin, giving the results of the analytical work, have been published under your direction during the year.

MINERALS AND MINERAL WATERS.

The numbers of minerals and miscellaneous samples examined has increased considerably over last year. The demand for the analysis of mineral water is very great—much greater than can be complied with owing to the limited time at the disposal of this Division for such work. I think it necessary in the future to place greater restrictions on the analysis of water than formerly, and only analyze such water as is of positive value and which the owner expects to make some special use of. In addition to the above restrictions I would repeat my recommendation of last year, "that a charge of five dollars be made for each mineral water analyzed in order to prevent people from sending in samples from idle curiosity,"

Respectfully submitted.

E. W. MAGRUDER,
Chief Chemist.

FINANCIAL STATEMENT

Receipts and Disbursements for fiscal year ending September 30, 1906.

EXPENDITURES.

Expense of Board	$ 1,538 39
Expense fertilizer inspection	6,268 39
Express, telegrams and drayage	330 87
Expense Farmers' Institutes	3,400 00
Hand book	685 25
Incidental expenses	105 90
Laboratory	1,545 73
Museum	168 50
Office expenses	511 72
Printing	5,482 42
Salaries	10,013 97
Stationery and postage	1,276 07
Special bulletins	2,500 00
Test Farm	2,880 25
Expense collecting Jamestown exhibits	101 45
Partitions for offices	650 00
Expense advertising Virginia's resources	139 60
Expense Convention Southern Commissioners held in Richmond	250 00
Farmers' Institute trains	553 80
Fertilizer tags	1,299 18
Farmers' bulletins	317 94
Premium on bond	75 00
Special assays	3 00
State Horticultural Society	500 00
Traveling expenses	173 30
Total	$40,770 73

RECEIPTS.

Balance October 1, 1905	$12,032 47
Receipts from fertilizer tax	39,370 36
Total	$51,402 83
Expenditures	40,770 73
Balance October 1, 1906	$10,632 10

PURE FOOD FUND.

DISBURSEMENTS.

Salaries	$ 1,832 50
Inspection	512 49
Apparatus	352 65
Rent	289 00
Total	$ 2,986 64

RECEIPTS.

Balance October 1, 1905	$ 567 83
Appropriation by Legislature	5,000 00
Total	$ 5,567 83
Expenditures	2,986 64
Balance October 1, 1906	$ 2,581 19

Information of Value to the Farmer.

AGRICULTURAL EDUCATION PAYS.

Many popular lecturers and teachers strongly emphasize the purely cultural effects of agricultural education. They place these above the commercial possibilities which a technical knowledge of agriculture reveals. By minimizing the value of knowledge as a means to greater material prosperity and magnifying its higher potentialities they deal a blow at the very object of their cordial approbation.

This is an age in which the dollar is exhibiting its maximum power in America. All the old nations have passed through the same sordid period of devotion to lucre. The commercial spirit has always preceded epochs of intellectual advancement and ethical progress. When a people satisfies its hunger for this world's goods and comes to understand the basic poverty of great wealth it turns toward genuine culture. America is so new and so rich that commerce instead of art will be its ideal for many years to come; therefore the most effective argument in favor of agricultural education or broad knowledge in any line is that it pays in dollars and cents.

Farm boys attend agricultural colleges and schools because of the larger financial opportunities that technical training offers. Knowledge is power to earn more money. Agricultural education expands the monetary possibilities of farming. It pays the man who has it. It does more, but it is attractive to present-day agricultural people just in proportion to its demonstrated ability to make their business more remunerative. Money is the master that will drive the people to lofty heights of true greatness. The more money the farmer makes the broader his foundation or that of his posterity for subsequent growth in the higher attributes. Culture has never gone before, but has invariably proceeded from material development.

Agricultural America must attain a much higher degree of commercial strength before it will take kindly to the advice of those who with excellent intentions are preaching culture and disparaging commerce. At present agricultural education must pay in dollars if it is to interest the people generally; its cultural results are incidental, however valuable. Some day the floodtide of prosperity will be diverted to the channels that lead to life's highest development. Agricultural education will hasten its coming.

THE MOST PROFITABLE TYPES OF CORN FOR FARMERS.

The average Missouri farmer is vastly more interested in a type of corn that will yield largely than in one that will score high on the show tables. He has not studied to discriminate as to the lower feeding values of different corns, as indicated in the varying protein, oil or starch content, but looks only to the bushels of sound shelled corn that any given variety will produce. This is his measure of value, his standard of excellence. And in this he is right. Seek first a maximum yielding corn, and all the other subsidiary requirements may in time be added by judicious breeding.

The question then is, what style, size, shape of ear, sort of stalk and blades, what period of maturity and what general characteristics are identical with the best average yielding corn? I have watched the results in the growth of a great number of types of corn, in length of ear all the way from the "Long John," twelve to fourteen inches long, to the thick, short mastodon in size, from the Giant Normandy, Boone County White, and other extra large sorts to the Cartner, and other smaller varieties. As to size of grain, I have carefully observed from the large broad grain of the Hickory King to Shoepeg; as to number of rows to the ear from the eight-rowed to 30 or even 32 rows; and as to one ear to the stalk, or many ears, as is the so-called "Prolific" sorts; and I conclude that the medium, between the extremes, gives the best average results.

I come to this conclusion first upon the safe theory of the "survival of the fittest." Since I can first remember, at frequent intervals the extreme types have been introduced and tried, but fully 80 per cent. of the farmers have swung round to the use of the medium sizes and one ear to the stalk. J. O. Roberts, of Clarksville, who has had a wide and varied experience in raising and handling corn, as a farmer on rich bottom land, on medium land and on hill or high upland, also as a miller for a long period, and thirdly as a dealer buying corn from thousands of crops, said to the writer, "After all, the most satisfactory kind for all kinds of land and all kinds of seasons, and the safest to plant is a medium-sized white corn."

To be more specific, ten inches long should be the maximum. This would mean that very large percentage of ears grown on average land would fall short of that from one to two inches. The ratio of three to four for circumference to length remains unchallenged. The size of the kernels is of some importance. Having measured many hundreds of samples of high producing crops, I would prefer the following dimensions: Length of grain, one-half inch to nine-sixteenths; width of grain, five and a half sixteenths; thickness of grain, two and a half sixteenths. The shape of grain should be key stone, as nearly straight on edges as possible, thus filling all the space. The rows should extend three-sixteenths of an inch beyond the cob at the butt, and to within three-sixteenths of an inch of end at tip. The evident result of closely fitting, solid, deep grains, and the extension at the butt is to get the greatest amount of corn possible on a cob of a given size. The reason I would not encourage the extension of grains to the extreme tip of the cob is that at this point is the most hazardous place to grow corn. It is subject to all the vicissitudes and damages of weather, birds and insects, and energy expended in growing grains as the extreme tip is more often than otherwise lost. The only way to guard and protect it is to have the corn shortened so that the shuck will cover it completely. If the size of the ear and the size of the grain are both to be maintained, then it follows that a uniform number of rows must be established. I have found that eighteen rows give grains about the right size on ears or normal size. Very large, broad grains, as a rule, are rounded and do not fit closely on the cob. On the other hand, the sharp-pointed grain carries too small a germ for strong germinating powers. Thin, flat grains are objectionable from the same cause. A medium thick grain, carrying a deep, large germ, is the better yielding type.

Having outlined an ideal type of corn that any farmer can produce, let us see what it would mean in bushels of corn planted by check row, three feet eight inches would have 3,240 hills to the acre. Two stalks to the hill, each stalk bearing a ten-inch ear would mean over ninety bushels to the acre. I say over ninety, for I have weighed hundreds of sample ears, and they will average over one pound each, and if well filled and matured, will shell out one hundred bushels. What does the farmer want with bigger corn than that? But let us drop to nine inches in length and 14 ounces each, and we get right close to eighty bushels. Eight-inch ears should weigh 12 ounces, and that would mean sixty-seven bushels. But suppose we try raising nubbins weighing only eight ounces each and get 45 bushels to the acre, and we are then five bushels above the maximum average yield of the State for any one year in her history, and fifty per cent. above our ten-year average. It is evident then that our weak point in corn production is not want of size of ears, but want of uniformity. It is safer and easier to get uniformity in the smaller and medium types than in the large. I once got a package of corn from Washington called the "Giant Normandy." I gave it a good trial. The ears varied in size from two ounces to two pounds. It had

CORN BREEDING INSTITUTE TRAIN.

Farmers' Overflow Meeting at the End of the Day's Run of the Farmers' Railway Institute Train.

no redeeming trait; in fact, it was a sort without any prepotency toward uniformity. If the Missouri farmer could procure a strain of corn with fixed prepotency to such a degree that every stalk would produce an ear, even a ten-ounce ear, it would beat anything he has now. I repeat, the great need of to-day is uniformity in productivity. This trait may be bred into the corn by selecting from the rows producing the greatest number of ears of a uniform size. The idea of selecting the abnormal in size is only aggravating the evil.

Uniformity in ear development can only be had from uniform stalk growth. We often notice great divergence in size and form of stalks all growing along under apparently the same favorable conditions; some small and spindling and others low and stock. These differences may be due to one of two causes; first, inherent tendency to variation for lack of fixedness of type, or it may be due, as Mr. Holden contends, to variable vitality in seed planted. The spindling dwarf or runty stalks might be the result of weakened seed, but the abnormally tall stalks and the tendency to barrenness is more apt to be inherent. In either case, uniformity of grain from typical, uniform stalks, grain strong in germinating power to be had by using grain of good size with full, healthy germ, is a means of securing uniform stand and uniform production. In my judgment it would be well if the farmers would discard the greater majority of various types now in use and use only two varieties, one of white and one of yellow. Or if for feeding purposes only, then one variety is enough. We are relying too much on far-off and much advertised sorts, and not enough on our own ability to modify our own corn to suit our own conditions as to climate, soil, etc. In the foregoing I have described what I deem to be the most profitable type of corn of Missouri, leaving it to the judgment of the reader to determine which of the varieties now in use best fills the bill.

Wishing the Missouri Corn Growers' Association much success and commending their earnest work, I respectfully submit this paper.—*G. W. Waters.*

STRONG VITALITY IN SEED CORN—HOW TO GET IT.

I will tell you how we gather our seed corn, and the different methods we have tried. I will tell you how the government is performing an experiment which extends over a period of almost five or six years on our farm—an experiment of the time of gathering seed corn and the nature of storing seed corn. I will also tell you what the authorities at

Washington, after a three years' experiment, have decided is the proper way to store seed corn.

We gather our seed corn as early as possible, but, of course, the time depends on the season. We gather just as long as we can before a hard storm sets in; a rain, followed by a hard freeze, or something of that sort, prevents the further gathering of seed corn. We generally expose that seed corn to a natural ventilation, a natural circulation of the air; or perhaps, we have such a constructed seed house that the ventilation will be forced. You can readily construct a seed house of that sort yourself by making a series of doors along the sides, place your seed house well up from the ground; and then putting in the cone of the roof especially constructed windows. We use kiln-drying windows, which create a suction up; these are used in kiln-drying houses; and you know that if kiln-dried corn ever becomes dampened again, it is spolied; consequently there must be a supply of hot air all the time—no moist air can come in. The corn that is gathered about the first of October and stored either in crates, or loosely thrown in, in such a seed house, or hung up on a series of wires along the roof of the seed house, is the very best germinating corn I know of.

Now, we attempt to dry the corn as rapidly as possible; we attempt to drive off all the moisture; and then to keep the seed house at a temperature of a uniform heat, usually kept 35 degrees above zero. During the winter there are cold snaps where the thermometer will go down to 20 degrees below zero; and we have had instances where corn will absorb moisture, and a freeze will follow, and the germination is lowered and vitality is hurt very greatly. We have kept our seed houses at such a temperature during those cold snaps that there is no danger of any such results. We have had differently constructed seed houses; we have tried forced ventilation, and circulation without artificial heat, and we find it does not give us as good results as when we keep the temperature above that very low point. I should say we should not let the temperature get below 10 above zero. Now, in our work, I don't know of an instance where it has gotten below 20 degrees above, but 10 degrees is low enough for the danger point.

The government have selected what they call four stations on the farm—one being an open crib, two artificially heated seed houses and one of the old type of seed house—that is, the seed house without the artificial heat. They have taken three varieties of corn. They start gathering about the middle of September; they have a man who does no other kind of work on the farm but this; he gathers twice a week. They have a half bushel of each variety for each station. After gathering, the man in charge takes a sample of corn he gathers at that time and also a sample of corn gathered previously, and sends these samples in sealed bottles to Washington, where they are analyzed and the moisture content is taken and the germination is taken at that time. You can see that as the season advances this work increases, because he has to take a sample of each gathering he has made previously. Consequently, at the end of the season, which last year was about the middle of January, this work means a great deal, takes up all the man's time in taking these samples and sending them to Washington. This year they only made one gathering a week and stopped gathering the middle of December. I will try and give you a few of the results from these different gatherings.

The germination of the open crib for the gathering up to the 20th of December was 92 per cent.; 94 per cent. for the seed house without heat, and 96.8 for the heated seed house. The corn gathered in September did not germinate as well as the corn gathered in October; neither did the corn gathered in December germinate as well as the corn gathered either in October or September. After about the middle of January we received our first blow from the north; it turned very cold, 28 degrees below zero. At that point, the germination in the open crib dropped to 64 per cent.; the germination in the unheated seed house dropped to 86 per cent.; and the germination in the heated seed house increased to 97 per cent.; the germination in the heated seed house remained practically fixed—just as good after the hard freeze as before. They have registering thermometers in all these stations, giving the temperature every hour of the day. The registering thermometer in the seed house without heat went to 24 degrees below zero. In other words, that cold snap brought the germination in the open crib from 92 to 68, in the unheated seed house from 94 to 86, and the germination in the heated seed house remained the same. Now they took ten gatherings from these different varieties at the four stations and planted them in plots, the gathering extending from the middle of September to the middle of January. In the field the difference in germination was more noticeable than it was in the germination at Washington. Not only was the germination of the open crib very poor, but the vigor with which the corn grew that did sprout was very poor—it lacked vigor and color and strength, and the germination in some of the rows from the open crib went as low as 6 per cent.—practically killed it all. The heated seed houses germinated about 94 and the unheated seed house germinated about 80. They are going to continue this experiment, and the data they get later on will be more valuable. I think, however, it will result just about the same as it has. I think the heated seed houses are essential, but I think that temperature of the corn should not be allowed to drop below 10 to 20 degrees above zero. Mr. Hartley, in a paper read before the American Corn Breeders' Association last year, made this statement: That from the klin-dried corn (this experiment extends over a period of three years), they received a yield exceeding the natural dried corn over 15 bushels per acre; that is, the kiln-dried corn yielded 15 bushels more per acre than the natural dried corn. Now, I don't know whether he kept the temperature up above the freezing point or not, but that was the statement he made.

Now, for the ordinary farmer, I think the best method for him to gather his seed corn is to go out early and pick a few ears that are of the proper size and of the right uniformity, and hang them up above the driveway in the barn, where they will get all the ventilation possible, and before damaging weather comes on place them in the house. You can put them in the house some place where they will be out of the way and there the temperature will be kept normal.—*E. D. Funk.*

EXPERIMENT WITH OATS.

SUMMARY.

Experiments extending over a period of ten years are summarized in this bulletin.

The oat may be made a much more profitable crop than it now is, provided farmers will make the two following innovations in the usual method of caring for the crop: (1) Sowing in the early or middle fall. (2) Applying nitrate of soda as a top dressing in March, or sowing on land where a soil-improving crop like cow peas has recently grown.

In tests of varieties extending over a number of years there was little difference in the yields of Red Rust Proof, Appler, and Culberson when sown in the fall. These three varieties are practically identical.

Turf or Grazing oats sown in November afforded only 59 per cent. as much grain as Red Rust Proof oats sown at the same time. The order of ripening of the principal varieties sown in the fall was Burt, Red Rust Proof, and Turf.

Red Rust Proof oats may be distinguished from other varieties usually grown in the South by the long beards which are usually present on both grains, by the brownish yellow color, by the plumpness of the grain, and still more positively by the greater length of the tiny hairs or bristles located at the base of the lower grain.

Red Rust Proof and related varieties or strains, Appler and Culberson, constitute the best general-purpose type of oats for this region, being suitable for either fall or February sowing, and having stiffer straw and greater rust-resistance than any other variety tested.

The Burt oat, (synonym May oat), is chiefly valuable for its earliness, and hence for sowing at a rather late date in spring. When sown in November it was almost completely winter killed in the severe winter of 1904-5, but it was uninjured during the mild winter of 1905-6.

Winter killing of oats may be greatly reduced and the crop almost insured against ordinary winters by using one or more of the following methods:

(1) Sowing in October or September.

(2) Sowing with a grain drill.

(3) Use of a roller after the plants have been heaved and their roots exposed.

The average of seven experiments made in seven different years shows that Red oats sown in November averaged 11.3 bushels per acre more than when sown in February. This is a profit of $5.65 per acre, or an increase of 73 per cent. as the result of sowing in the fall. October is advised for fall sowing, and the first few days in February for spring sowing in this latitude.

Smut of oats can be entirely prevented by moistening the seed in a mixture of one ounce of formalin and three gallons of water.

Nitrogenous fertilizers have been much more profitable than phosphate or potash on the sandy and loamy soils at Auburn, but it is recommended that on such soils at least 100 pounds of acid phosphate be applied at the time of sowing oats.

Among the various nitrogenous fertilizers a pound of nitrogen or a dollar of investment has been most effective in nitrate of soda, and somewhat more effective in the form of cotton seed meal than of cotton seed. When either cotton seed or cotton seed meal is used it should be applied at the time of sowing, but nitrate of soda is most useful when used in March after growth begins.

Barnyard manure greatly increased the yield of the crop of oats to which it was applied, and exerted some effect on the next crop. In one experiment it required 43.1 pounds of nitrate of soda and 103 pounds of acid phosphate (costing together $1.93) to afford the same increase as one ton of fine, fresh, unleached horse manure.

In thirteen experiments with nitrate of soda the yield and total profit per acre increased with the amount of nitrate applied up to 200 pounds per acre. However, the smaller applications were more economical. The cost of nitrate of soda required to produce one additional bushel of oats was 14.5 cents from the use of 63 pounds per acre; 17.7 cents when nitrate was applied at the rate of 100 pounds, and 21.1 cents when 200 pounds of nitrate of soda was used per acre. The smallest application afforded a profit over the cost of fertilizer of 249 per cent.; the use of 100 pounds of nitrate per acre returned a profit of 206 per cent. on the cost of the fertilizer, while the heaviest application resulted in a net profit of 140 per cent. The three different amounts of nitrate of soda gave profits per acre of $4.73 for the light application, $6.19 for the 100-pound application, and $8.40 for the 200-pound application. Sixty to 100 pounds of nitrate of soda is recommended to be applied as a top dressing to oats in March.

No nitrogen need be purchased for oats, provided the oats be sown after a crop of cow peas, velvet beans, peanuts, or soy beans, all of which crops, whether only the stubble or the entire growth was plowed under for fertilizer, afforded an increase in the succeeding oat crop of from 6.2 to 33.6 bushels per acre. From 5 to 15 bushels increase in the succeeding oat crop is considered an average result of the use of the stubble or vines of leguminous crops employed as fertilizer.

FERTILIZER FOR OATS.

It is a custom far too common in Alabama to sow oats without any fertilizer. The experiments here recorded show that it pays to fertilize oats, and that the most profitable fertilizer is one that is rich in nitrogen. Omitting the long table of figures, the conclusions drawn from average results of a number of years' experimentation in Auburn are here given. On our sand and loam soils rather heavily fertilized with complete commercial fertilizers for a number of years, the results were briefly as follows: Potash was practically useless; acid phosphate was of secondary importance, while nitrogen in whatever form applied, whether as stable manure, cotton seed, cotton seed meal, or nitrate of soda, gave a considerable increase in the yield of oats.

BARNYARD MANURE AS A FERTILIZER FOR OATS.

For several years an experiment has been in progress to determine the increase in various crops due to the application of manure during the current or previous season. Only such of these data as bear on the oat crop are here given. In the winter of 1900 heavy applications of cattle manure, obtained by the use of a ration of cotton seed meal or of cotton seed, were applied to fall-sown oats. The following table shows the results obtained the first year, in which the increase in yield was 29.6 or 31.5 bushels of oats per acre:

Immediate or first year effect of cattle manure applied to oats

Manure per acre.	Manure from feeding.	Yield per acre.	Increase per acre.
Lbs.		*Bus.*	*Bus.*
43,740	C. S. Meal, etc.	40.7	31.5
30,600	Cotton Seed, etc.	38.8	29.6
No manure.		9.2	

The next year oats were again grown on the same field without additional fertilizer.

Manure per acre previous year.	Yield per acre second year.	Increase per acre second year.
Lbs.	*Bus.*	*Bus.*
43,740	37.5	26.
30,600	28.	16.5

Even on this sandy soil a heavy application of stable manure gave a large increase in the second crop of oats, as well as in the crop to which it was directly applied.

NITRATE OF SODA AS A FERTILIZER FOR OATS.

Numerous experiments made under the writer's direction both on sandy loam at Auburn and on stiff lime lands at Uniontown show that this is by far the most effective commercial fertilizer for oats. The following table affords means of comparing nitrate of soda with cotton seed meal, cotton seed, and stable manure, which are the principle sources of fertilizer nitrogen available to the southern farmer.

Cotton seed meal, cotton seed, nitrate of soda, and manure as fertilizers for oats.

Amount per acre.	FERTILIZERS.	Yield and Increase per acre.						Average increase per acre due to Nitrogen.
		1901			1606			
		Yield straw.	Yield grain.	Increase in grain due to Nitrate.	Yield straw.	Yield grain.	Increase due to Nitrate	
Lbs.		*Lbs.*	*Bus*	*Bus.*	*Lbs.*	*Bus.*	*Bus.*	*Bus.*
200 240	Cotton Seed Meal Acid Phosphate..	827	24.9	8.0	1788	42.9	13.0	10.5
434 240	Cotton seed Acid Phosphate..	774	24.2	7.3	1136	32.1	2.2	4.8
240	Acid Phosphate	532	16.9	0.0	1160	29.9	0.	......
100 240	Nitrate of Soda (in spring) Acid Phosphate........	1130	36.3	19.4	1776	55.8	25.9	22.7
100 240	Nitrate of Soda (at planting) Acid Phosphate..............	1222	36.0	19.1	2128	54.4	24.5	21.8
4000	Manure........................	1152	34.4	17.5	2152	51.5	21.6	19.6

Referring to the figures in the preceding table, we have the following comparison between the results of 2 tons of fine horse manure and an application of 100 pounds of nitrate of soda together with 240 pounds of acid phosphate, the phosphate being applied at time of sowing in the fall and the nitrate being applied as a top dressing in March.

With two tons of fine horse manure applied in the fall the average increase was 19.6 bushels of oats per acre; with the commercial fertilizer mixture the average increase was 22.7 bushels of oats. In other words equal first-year results were obtained from the use of one ton of manure as from 43.1 pounds of nitrate of soda aided by 103 pounds of acid phosphate. With nitrate at $60 and phosphate at $12.50 per ton these amounts of commercial fertilizer cost $1.93. Hence the farmer could afford to invest at least this amount in the production or purchase and very thin distribution of one ton of fresh unleached horse manure, and still be ahead by the greater effect of manure than of chemicals after the first year. We have seen in a preceding paragraph that the second year effect of a ton of manure on our sandy loam soils is equivalent to more than one bushel of oats per acre.

While the application of stable manure to oats on poor land is to be commended, yet the limited supply of this material makes it necessary for the farmer to purchase nitrogen in commercial fertilizers. Probably even better use for manure can be made than to apply it on oats, thus making it necessary to purchase nitrate of soda for oats and other small grain.

The following table shows the results of 13 different experiments conducted under the writer's direction at Auburn and Uniontown, Ala., and bearing on the effects of nitrate of soda applied in March as a top dressing for oats:

Year.	Date of Sowing Oats.	Amount of Nitrate per acre.	Date of Applying Nitrate.	Yield per acre.	Increase due to Nitrate.	
Fall sown		*Lbs.*		*Bus.*	*Bus.*	*Per cent.*
1904	Nov. 4	200	March	49.5	32.3	188
1903	Oct.	200	March	43.8	25.3	137
Av.		**200**		**46.7**	**28.8**	**163**
1906	Nov. 20	120	March 13	34.2	21.8	176
1901	Nov. 15	100	March 18	36.3	19.4	116
1906	Nov. 15	100	March 13	55.8	22.7	69
1903	Oct.	100	March	34.0	14.8	77
1904	Nov. 4	100	March	42.3	17.0	67
Av		**100**		**42.1**	**18.5**	**82**
1896	Oct.	80	March 28	29.3	12.9	79
1906	Nov. 20	60	March 13	28.0	15.6	126
1904	Nov. 4	50	March	29.0	11.3	64
Av.		**63**		**28.78**	**13.3**	**90**
Spring sown						
1896	Jan. 27	120	March 28	20.3	9.9	95
1903	March 19	80		29.0	8.0	38
1900	Feb. 20	76	March 25	19.7	7.4	60
Av.		**92**		**23.**	**8.4**	**64**

WHEN TO APPLY NITRATE OF SODA.

The experiments conducted in Auburn, and recorded in Bulletin No. 95 of this Station, indicate that nitrate of soda should be applied early enough to give at least 55 days before the time of application and the probable date of harvesting the grain. Any time in March is suitable. We have found nitrate of soda applied as a top dressing in March more effective with oats and wheat than when put into the ground with the seed in the fall. The superiority of the spring application has been greater with wheat than with oats and much greater on quite sandy soil than on gravelly soil containing considerable clay, on which stiffer soil both fall and spring applications have greatly increased the yield of oats.

All lumps in the nitrate of soda must be carefully pulverized. The fertilizer is strewn by hand, and distributed as evenly as seed oats or seed wheat would be. No covering or harrowing is necessary. This fertilizer is so readily soluble that a small amount of moisture in the soil will dissolve it and carry it downward to the plant roots. It is best to sow nitrate of soda when the ground is somewhat moist, but one should avoid applying it just before a rain, which might wash away a large part of the nitrogen. Hence if practicable we prefer to apply nitrate of soda just as the weather clears after a period of rainy weather. We usually apply this fertilizer to oats about the middle of March, though application at any date within that month is satisfactory.

LEGUMINOUS PLANTS AS FERTILIZERS FOR OATS.

Cowpea or velvet bean stubble on entire growth as fertilizers—We have seen that of the commercial fertilizers the one best adapted to oats is nitrate of soda, but since the use of this material involves a cash expenditure we may well inquire whether some fertilizer material produced on the farm may not act as a substitute. The pricipal materials that might thus be used are barnyard manure, which has already been discussed, and leguminous plants, such as cowpeas, soy beans, velvet beans, etc. But the entire plant and the roots and stubble alone of these legumes are rich in nitrogen and hence useful as nitrogenous fertilizers. The following table, quoted from Bulletin No. 95 of this Station, gives the result of an experiment in which the use of either the stubble or entire plant of cow peas or velvet beans afforded an enormous increase in the yield of the succeeding crop of oats, an increase larger than we can usually count on. The Red Rust Proof oats were sown in the fall of 1897 and the crop was cut May 18th following.

On all plots oats were fertilized with 220 pounds per acre of acid phosphate and 44 pounds of muriate of potash, no nitrogen being supplied except that contained in the remains of preceding crops of cowpeas, velvet beans, etc.

Yield per acre of oats grown after stubble or vines of cowpeas, velvet beans, etc.

Plot No.		Yield Per Acre.	
		Grain.	Straw.
		Bus.	*Lbs.*
1	Oats after velvet bean vines.	28.6	1206
6	Oats after velvet bean stubble.	38.7	1672
	Average after velvet bean vines and stubble	**33.6**	**1439**
4	Oats after cowpea vines	28.8	1463
3	Oats after cowpea stubble	34.4	2013
	Average after cowpea vines and stubble	**31.6**	**1738**
2	Oats after crab-grass and weeds	7.1	231
5	Oats after German millet	9.7	361
	Average after non-leguminous plants	**8.4**	**296**

From early spring there was a marked difference in the appearance of the several plots, the plants being much greener and taller where either the stubble or vines of cowpeas had been plowed under.

When the oats began to tiller, or branch, the difference increased, the plants supplied with nitrogen, through the decay of the stubble of vines of cowpeas and velvet beans, tillering freely and growing much taller than the plants following German millet or crab grass.

In this experiment the average yield of oats was 33.6 bushels after velvet beans, 31.6 bushels after cowpeas, and only 8.4 bushels after non-leguminous plants (crab-grass, weeds and German millet.)

Here is a gain of 24.2 bushels of oats and nearly three-fourths of a ton of straw as a result of growing leguminous or soil-improving plants, instead of non-leguminous plants during the preceding season.

OATS AS A HAY CROP.

Good hay is made from oats cut when in the early dough stage.

On deep, gray, sandy soil (Norfolk sandy loam) two plots of Hatchett's Black oats were sown October 24th. Both were fertilized at the time of sowing with 360 pounds of acid phosphate and 48 pounds of muriate of potash. The plots receiving no nitrogen yielded 678 pounds of cured hay per acre. The plots fertilized March 20th with 80 pounds of nitrate of soda per acre yielded 2,120 pounds of hay, or about 3½ times as much as the plots without the nitrogen. From this late variety of oats the hay was ready to cut May 15th. With Red oats the date for cutting oat hay is usually earlier.—*J. F. Duggar, Ala.*

MANAGEMENT OF SOILS TO CONSERVE MOISTURE.

MOVEMENT OF WATER IN SOILS.

The greater part of the water that falls as rain passes into the soil. The proportion that runs off without entering the soil varies with the compactness and inclination of the surface and with the character of the rainfall. The water which does enter the soil passes downward, the free or gravitational water which forms visible liquid layers on the soil grains or occurs between them being pulled down by gravity. The water held by the soil particles against the force of gravity is called capillary water. It cannot be seen as liquid water, but its presence may be recognized by its effect upon the color of the soil. If in too great quantity to be disposed of by capillarity, the rain water runs down into the lower soil and finally joins the so-called ground water, also called bottom water, or permanent water, raising its level temporarily. In drying weather the capillary water evaporates from the surface of the soil, the soil drawing more water from below, but not in sufficient quantity wholly to replace that lost by evaporation, and there is, therefore, a continual decrease in the content of capillary water until another rainfall. The free or permanent water may rise into the soil as capillary water to replace that lost by evaporation, and it is constantly running out of the soil into the natural drainage channels as spring and seepage waters. These several motions of water all take place when the rainfall is sufficient to give an excess over what the soil can hold in what has been called the capillary state.

If the surface soil is open and loose, heavy rains completely fill the pore spaces of the upper soil. When the pulverized layer is thin, it often becomes so soft and filled with water that this loose layer washes and greatly injures a field.

THE IDEAL TILTH.

It is from capillary water that agricultural plants, for the most part, obtain the water necessary to their growth. In order that they may make their best development, the soil must be in such physical condition that the roots of plants can readily penetrate it and ramify through it; it must contain sufficient capillary water to supply the needs of the plants; and this water must be renewed as it is taken up. There should be no large air spaces, since these cause the soil to dry out readily and prevent the development of the many fine branching rootlets necessary to the best development of plants. It is somewhat difficult to describe in words this proper mechanical condition of the soil. It is porous but not loose; firm but not hard nor consolidated; close-grained but not run together nor adhesive. The ideal condition is that of a good loamy soil which has been thoroughly pulverized when in best condition as to moisture and has then been firmed by pressure. The pulverizing breaks the soil into granules which the pressure brings close together without destroying them. The soil still has a mealy or crumbly texture. In such a soil the roots of plants make their best development. In such a soil, too, beneficial bacterial life finds its most favorable environment. Such soils will take up and hold the most water, not as water is held in a dish but rather as it is held in a sponge. It is free to move under capillary forces and yet it does not exclude the air, not interfere with any of the vital, chemical, or physical processes in the soil but is conductive to them. The capillary water in such a soil and the mineral nutrients it contains are readily reached and absorbed by the extending roots of plants.

The soil as a whole is generally drier when the crop matures than it was at seeding time. In this case all the rainfall during the growing season has been lost from the soil by drainage and by evaporation from the soil and from the crop, and some of the water already in the soil at seeding time has likewise been lost. This being true, a condition of soil that will take up the greater proportion of the rainfall and will dispose of it as capillary water is to be desired.

EFFECTS OF TILLAGE.

Proper tillage has two important effects. First, the soil is brought into the desirable condition already described, so that there will be a deep, mellow, but firm seed and root bed to absorb and store the rainfall and to prepare plant food, and, second, the loss of water by evaporation from the soil is prevented as far as possible. The operations of tillage may be considered under two heads—the preparation of the seed bed, and the cultivation of the growing crop. In general, plowing is the most important of the operations in preparing the seed bed, since it is universally applicable; but there are special cases where draining is the first requisite in bringing the soil into condition.

DRAINAGE

Need of air in the soil—There are flat lands and heavy clays where a system of tile drains is of more value than any other treatment that can be given them. Such soils hold water within them in a form that has been designed as free water, or gravitational water—that is, water that is free to move under the influence of gravity. Such a soil acts like a dish or other vessel. There are several disadvantages or injurious consequences resulting from having a soil so filled with water. There can be no circulation of air within the soil. The oxygen of the air is necessary in soils for the direct use of plants. Their roots can not grow and extend into the soil to find water and food constituents except in the presence of oxygen. Seeds cannot germinate in the absence of oxygen. Microscopic organisms, which are so essential in properly mantaining the fertility of soils, require oxygen just as higher organisms do. The decay of organic matter in the soil in the presence of oxygen is of such character that its products are usually favorable to plant growth. Nitrates, generally the most important element of plant food, are produced in the presence of free oxygen only.

Disadvantages of wet soils—The entrance of this essential oxygen of the air into soils is hindered when the pores of the soil are filled with water. Such soils cannot be worked until late in the spring, because of being too wet. This delays planting. Wet soils are cold, because the water as well as the soil must be heated, and water warms up much more slowly than soil. The removal of the excess of water by draining permits the heat of the sun to warm the soils earlier to a proper degree for the germination of seeds. Clay soils, when too wet, run together and become plastic and difficult to penetrate by water, air, and the roots of plants. When they dry out by the later heat of summer they bake and become hard and cloddy, are difficult to till, and are in every way unsuited for cropping. If they be plowed when too wet they become still more puddled, and it requires protracted weathering to bring them into fair condition again. Moreover, these wet soils, both clays and mucks, often contain noxious substances, which interfere with the growth of the most valuable farm crops. These noxious substances are doubtless mainly organic, but may also be mineral. If the excess of water be removed by drains, these noxious substances are washed out or they are oxidized by the air that finds access to the soil and by the growth of bacteria. Through the weathering processes that go on in drained soils, they become less plastic and less consolidated, so that drainage becomes more perfect and the friable root bed is deepened. Crops on these drained soils endure drought better than they did before. In the early part of the growing season, while plants are establishing their root systems, the undrained soils are full of water near the surface. Plants cannot send their roots into this stagnant water, and hence are shallow rooted. Later, if dry weather comes on, the upper soil dries out, and the roots, being near the surface in this dry upper soil, cannot supply sufficient water for the needs of a good crop.

All heavy and mucky soils are better for being thoroughly drained. If not naturally so, whether tiles should be laid or whether open drains will be effective must be determined by inspection in each particular case.

Depth of drains—Generally the deeper the tiles are placed the more effective and perfect the drainage, and also the more expensive. Drains should, of course, be laid below the frost line and out of the way of all tillage operations. They should be laid by the use of a level, so that there may be no sags or traps in the drain, and the outlet should be such that the water runs freely from the tile.[a]

SUBSOIL PLOWING OF DRAINED LANDS.

Heavy clays that require under-drainage are generally benefited by subsoiling; that is, by breaking up the lower soil without bringing any of it to the surface. This facilitates drainage and adds to its good effects. There are two forms of subsoil plows. The one consists essentially of a curved bar of steel which, when drawn through the soil, tears it up after the manner of a very large harrow tooth. The other bears a wedgelike shoe on the lower end of the bar. It breaks up the subsoil more than the preceding, but is of heavier draft. The more usual procedure in subsoiling is to turn the surface with a common stirring plow, as in ordinary plowing, and follow in this furrow with the subsoil plow. This loosens the soil to a depth of 18 to 24 inches from the original surface. The next furrow of the stirring plow

A good form of subsoil plow.

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[a] Farmers' Bulletin No. 187, U. S. Department of Agriculture, treats quite fully the subject of the drainage of farm lands, giving detailed instructions for performing the work, and, therefore, no special directions for constructing drains will be given here.

covers this loosened subsoil, and the subsoil plow is run in the bottom of the new furrow. Sometimes the subsoil plow is used without first turning the surface. In such cases it is not run so deep and its work is less effective.

The subsoil is commonly wetter than the surface soil. If a heavy clay, and it is stirred when too wet, it will become more puddled, neutralizing the effects of the plowing. Subsoiling should never be done when the subsoil is wet enough to be plastic and to cake on drying. It may require two or three years after putting in the drains for the subsoil to come into proper condition for plowing. The subsoiling should be done in a dry time of year, and then only when an actual examination of the subsoil shows it to be in condition to be worked without puddling of forming clods. When the subsoil has been put in the proper condition by the use of the subsoil plow, it will generally be necessary to repeat the operation only once every fifth or sixth year.

SUBSOIL PLOWING OF LANDS NOT DRAINED.

Recognizing the advantages of a deep, fine-grained seed and root bed, one that will absorb and retain a large quantity of water, the use of the subsoil plow has been widely recommended as a means of producing it. Its use for the purpose of deepening the soil reservoir and the feeding ground of the roots of plants is so distinct from that given under the preceding heading, where its object is principally to facilitate drainage, although it accomplishes more than this, that its value in the one case can be no certain criterion as to its value in the other.

Experience seems to justify the following conclusions regarding the subsoiling of dry fields:

(1) Light sandy soils are not profitably subsoiled. Deep plowing of these will give the necessary condition for absorbing the rainfall, and for the extension of the root systems of plants.

(2) Unless the soil has been settled to firm it and to re-establish capillary connection with the lower soil, yields will frequently be less on subsoiled land than on that surface plowed. Heavy rains will settle the soil and fill it with water so that the effects proper to this preparation may be expected. But until these rains do come, the soil will have had no chance to exert any increased absorbing capacity it may possess, and, being loose and open and disconnected from the lower soil, will dry out more rapidly and completely than a soil not so thoroughly broken up. The subsoiling should be done in such season of the year that rains will intervene before seeding time.

(3) If subsoiling be determined upon, it should be in the nature of an experiment to see how it works on the particular soil concerned. If good results follow, the subsoiled area may be extended.

(4) In subsoiling dry fields it will often be better to use a plow with a subsoiling attachment, running it a few inches below the bottom of the furrow, gradually attaining the despired depth by plowing deeper year after year. In this way the soil will never be so much disturbed, and treatment for "packing" and "firming" it will be more effective. It will also be less expensive to prepare the soil in this way than to run a regular subsoiler 12 to 18 inches deep in the bottom of the furrows. But it will, of course, take a longer time to secure the deep soil reservoir.

PLOWING.

Plowing is the most usual method of fining the soil for planting; draining and subsoiling, when required, are preliminary preparations. When soil is well drained, either naturally or artificially, plowing is all that is required to bring it into shape. There is more or less difference in character between the upper or surface soil and the subsoil. Farming operations effect the former, and from it plants draw their nourishment in large part. It is a distinct advantage to have this cultivated soil or tilth as deep as it can reasonably be made. But in its natural state a comparatively thin layer only of the soil has been perfectly weathered and made in good condition to support plants. Where the soil is a clay or is underlain at a depth of 6 to 8 inches by a heavy clay subsoil, it will generally be found advisable to plow not more than 1 to 2 inches deeper than the soil has been previously plowed. By exposure and weathering the subsoil acquires the character of surface soil. In this way any desired depth of tilth may be produced without injury to crops. On open soils the dangers of deep plowing are not so great, but even here deep plowing should be done some time before the crop is put in. The soil will then have time to weather somewhat, and to settle and establish capillary connection with the soil below. This latter point is of importance, and will be considered more fully on a later page.

The sod plow—There are two distinct styles of moldboard plows. They differ in shape, and hence in their effects upon the soil turned by them. One may be called the sod plow, the share or cutting edge of which is generally longer and makes a more acute angle with the bar or landside than in the case of the other style. The moldboard has a gradual turn, inverting the furrow as a whole, but causing little motion within the furrow slice. Thus the soil is not pulverized very much.

Such a plow is quite serviceable in plowing sod; the furrow being placed flat, the grass dies readily and the roots rot rapidly. By the use of the disk and the harrow such rotted sod may be worked up into a fairly good seed bed. If sod ground be plowed while the grass is in active growth, the sod rots more rapidly and the ground comes into condition sooner than if the plowing be done in a season when the plants are dormant. Raw prairie sod requires a year or more to come into really good tilth, even if the breaking be done when the growth of the grass is most vigorous. This applies with most force to grasses having hard, tough roots, such as the blue stem of the western prairies. Tame grass sod comes into condition sooner.

The stirring plow—In the other form of plow the moldboard is shorter and has a steep upward curve, so that the soil is not only inverted but is pulverized by the shearing motion within the furrow slice. When a loam or a sandy soil is in proper condition of moisture no better tool for pulverizing it could be desired than a good plow of this latter form. If heavy clay soil must be plowed when wet, the sod form of plow will probably be preferable, since it disturbs the soil less and will not render it so cloddy. But if naturally hard soils have become dry they will be broken up more thoroughly by the steeper moldboard. Such soils should be plowed when in the process of drying; they have lost their plasticity, but have not yet formed clods. All soils should be handled with discriminating judgment, but heavy clay soils require the greater care to secure the best results from the work put upon them. The experienced farmer readily recognizes the condition each particular type of soil must be in to put in good tilth by plowing, but he does not always realize the advantage of doing the work at the right time.

Means of preventing "plow sole"—With these moldboard plows the smooth bottom of the furrow makes a distinct plane of separation between the soil that has been turned and that below. It is desirable to re-establish connection between these in order that excess of water from rains may readily sink into the ground, and that the water in the subsoil may rise by capillary action to reach plant roots occupying the upper soil. If this furrow bottom could have a rough or broken surface, capillary connection could be more readily established. In this respect the disk plow should be better, although it does not pulverize the soil so well. It is quite servicable on hard, gummy soil also. It would appear to be of especial use in humid regions where a hardpan or plow sole has formed at the depth the ground has been plowed. This hardpan has been formed in part by the action of the common plow itself. It separates the furrow by cutting, and the sliding of the plow over the flat and plastic furrow bottom puddles it, making a smooth, hard surface at the depth plowed. At successive plowings the plow runs at this depth, increasing the hardness and thickness of the pan. If the furrow slice were broken off instead of being cut off by the wedge-shaped plow the hardpan would not so readily form. The disk plow breaks off the furrow slice as described, and it may with profit be used occasionally to destroy this hardpan by cutting down into it and thus breaking it up. In fact the pan might be prevented from forming by the use of the disk plow every few years, running it quite deep.

A deep seed bed—By draining and subsoiling when necessary, and by deep plowing as has been described. a deep and pulverulent seed and root bed may be prepared. It is more than might be implied by these terms; it is a reservoir in which water that falls as rain will readily sink and in which a large proportion will be held in the best condition for the use of plants. It is a medium in which will take place the various chemical changes that prepare the mineral food of plants and destroy noxious substances. It is known that the innumerable bacteria that make their home in a mellow, well aerated soil perform important work in preparing it for the higher plants; but it is probable that their value is not yet fully appreciated.

WHEN GROUND SHOULD BE PLOWED.

For some crops the soil may be plowed immediately before planting and good results will be secured. This is true of corn. Wheat, on the other hand, especially winter wheat, requires a firm soil into which to send its roots, and plowing should not precede seeding by too short an interval. The soil should have time to settle before seeding. Heavy rains settle the soil, but since drier weather prevails in early autumn there is danger that the plowed soil will not thoroughly settle. When wheat or other fall crops are to follow a crop which is harvested in early or middle summer, and the ground is to be plowed for the wheat, the plowing should be done as soon after harvest as the condition of the farm work will permit, and the ground should then be smoothed with a harrow to reduce evaporation of the soil moisture.

Weeds use large quantities of water. Aside from other ill effects they may have, much of their injury to crops in which they grow is due to their appropriating the soil water. Where water is of any agricultural value weeds should never be allowed to grow. If stubble ground be left to grow up in weeds it dries out excessively. The early plowing urged above kills weeds and prepares the ground to absorb any rains that come, and the freshly plowed and harrowed soil will not lose water so rapidly as the stubble ground.

If land is to be planted in the spring late fall plowing has certain advantages. It may be done after the removal of a late-maturing crop. If the subsoil be turned up in the fall the freezing and thawing and general weathering will improve it. If rough, as left by the plow, the soil will absorb rains and melting snows and will crumble down into good condition and will not be so likely to run together as if smoothed by the harrow. Such fall-plowed ground will generally be in good shape for small grain seeded in the spring. The disk may be used if necessary. If corn is to be grown on fall-plowed land it should be thoroughly disked and harrowed unless the corn be planted with the lister. In case there be heavy rains before corn-planting time heavy soils will run together and cake. The disk run over these as soon as the surface had dried sufficiently will keep them in condition. In general, the disk should be used if there be a considerable interval between plowing and planting. In using the disk, lap half way to level the surface.

CULTIVATION TO RETAIN MOISTURE IN THE SOIL.

If the soil reservoir has been well prepared and rains have filled it with capillary water, tillage should be directed to reducing the loss of water by evaporation to the lowest possible point. The water that passes through the plants themselves is of benefit to the crop; that evaporating directly from the soil is wholly lost. In spite of all that can be done there will be losses from the soil in drying weather, but these may be materially reduced.

A loose soil with large pores has low capillary power and will absorb but little water from a moist soil in contact with it; therefore a layer of such loose soil covering the moist-soil reservoir will conserve the water in the latter by diminishing direct evaporation from it. It is well established by the experience of farmers, as well as by direct experiments, that a layer of loose dry soil 3 to 4 inches deep is effective in preventing the excessive drying of soils. If this mulch be maintained through the season by proper cultivation, it is more beneficial than a straw mulch. In the course of a long dry period it has been found to conserve the moisture as well as a straw mulch, and there are several disadvantages with the latter. If put on early, the straw mulch keeps the surface soil wet in the spring and early summer. This makes the soil cold, excludes the air, and causes plants to root near the surface. When this surface soil dries out, these roots cannot supply water and the crop suffers. The soil mulch and the cultivation to produce it cause the plants to root deeply, the aeration of the soil is improved, and in all respects the effects of the dust mulch are good. To be most effective the surface tillage must be kept up. The soil must be cultivated after each rain of sufficient amount to puddle the surface—that is, cause it to run together and form a crust on drying.

In a dry time it will pay to run a small-tooth cultivator through the corn, although it be later in the season than corn is usually cultivated and the plants are so tall that the double cultivator cannot be used If the soil has been kept loose on top the plants will have rooted below the dust mulch and the late culture of the surface will not injure them. It will aid in retaining moisture, will facilitate the aeration of the soil, and increase the activities of desirable micro-organisms.

It is usual to speak of a "dust mulch," but the better mulch has a granular structure and is not composed of dust. In open countries the dust would blow off, to the detriment of the soil, and a dust surface would not absorb the rainfall so readily as that composed of very small lumps of soil.

Tools used in cultivation—The implements employed in cultivation will vary somewhat with the crop and with its stage of growth. Tillage of ground before the crop is up and when the plants are very small, especially listed crops, should be with the spike-tooth harrow with the teeth set at a considerable slant. Weeds are most easily destroyed when they are coming up. The harrow is very useful for this purpose, and at the same time it produces the soil mulch. A distinct advantage in the use of the harrow is the rapidity with which the ground may be gone over. The spike-tooth harrow, or the disk harrow followed by the spike-tooth harrow, should also be used in summer culture intended to conserve moisture for a future crop. When the plants are too large to be cultivated with the harrow, any of the modern double cultivators will do good work in cultivating corn and similar crops; but when equipped with gangs of three to five narrow shovels that throw the soil but little, they are still more efficient for surface cultivation, unless the ground has become weedy from inability to cultivate it because of wet weather. Bladelike shovels that run nearly horizontal and cut off a thin layer of soil are effective unless there be too much trash. These blades can be so adjusted that the soil will pass over them, forming a loose layer, which on drying will protect the moist soil below.

In cultivating the soil as thoroughly and frequently as the best farming requires, the labor will be excessive unless tools be used that enable a man to cover a large area in a day. Plenty of team power should be available on a modern farm, and three or four good horses to one driver are more economical than two when the land is such that large tools can be successfully operated. Farming with one horse to a man is poor economy and will absolutely prevent the good farming necessary to conserve the soil moisture.

The disk harrow and the spike-tooth harrow have already been suggested for certain kinds of work. No better tools need be desired for the work for which they are designed. They are made in sizes for 2 horses and for 4 horses. In using the disk harrow it should be lapped half-way in order to leave a level surface. Disks 14 to 16 inches in diameter do better work than those of greater diameter, but the draft is heavier. Except in special cases, double cultivators, or two-row cultivators, should be used. Single cultivators are useful in cultivating crops that have become too tall for the double cultivator and.in small areas, as in truck farming, but no tool of less capacity than the double cultivator should be generally employed in field work.

ORGANIC MATTER AND THE CONSERVATION OF MOISTURE.

The organic matter in soils increases their water-holding power and improves their physical condition. This is one of the direct advantages resulting from the incorporation of humus in soils. The organic matter of soils is used up by oxidation during tillage and the soils become out of condition and run together and cake after heavy rains, unless this loss be made good. Organic matter may be increased in soils in several ways. It may be applied in the form of barnyard manure, straw, stalks, etc., and by green manuring—that is, by plowing a green, growing crop under for the special purpose of improving the soil.

Barnyard manure—Barnyard manure is the most valuable form of organic matter to add to soils, because it is rich as a fertilizer. For this reason the production and proper care of barnyard manure is just as necessary in farming as the growing of the staple crop. One of the great needs of some important agricultural sections is a great increase in live stock to produce manure and make possible the growing of a greater variety of crops, such as are required in an intelligent rotation.

Coarse litter—Where corn is the principal crop the stalks are generally cut as fodder; if not, they should never be burned, but should be cut and turned under; if fed to stock, the manure should be put upon the fields. Too often straw stacks are burned or permitted to rot down, and the various kinds of vegetable matter about the farm are burned or allowed to waste in outlots. It should all be added to the soil. The mechancial condition of the soil is improved by its decomposition, bacterial life prepares plant food from it, and by giving these agents a suitable home it would be valuable even if this were its only benefit.

In semi-arid farming wheat is often cut with a header. The straw left on the ground should be completely covered in plowing and the soil packed to facilitate the rotting of straw. Until the straw decays it will have an injurious effect, causing the soil to dry out more rapidly; but by cropping alternate years there should be no harm from this cause.

Green manuring—When plants are plowed under green, they decompose more rapidly than cured plants do. The crop should not be allowed to stand until it has exhausted the soil moisture. If left too long the soil will be cloddy, the plants will not rot well in the dry soil, and the soil may be too dry for a subsequent crop to get a good start. The ground should not be seeded until the material has decomposed.

The crop grown for green manuring will depend largely on the main object to be attained. If the principal consideration be to add organic matter, without regard to its nitrogen content, some quick-growing plant with heavy foliage should be selected. Oats, rye, sorghum, and even corn sown or drilled, are good crops to produce humus. The sorghum and the corn should be seeded close so as to make a large mass of vegetable matter and still not have large stalks.

Leguminous crops—Not only does the humus content of soils decrease during cultivation, but the nitrogen content does also. It will therefore generally be profitable to grow for green manuring a crop that adds this element to the soil. Leguminous crops, such as beans, peas, clover, and alfalfa, use atmospheric nitrogen through the medium of bacteria infesting the root tubercles, while grain crops cannot use it, but must get their nitrogen from the soil itself. A leguminous crop used for green manuring will add both humus and nitrogen to soils. The crop selected will vary with the climate. In the northern portions of the humid regions clover has been used as a nitrogen-gathering crop and is well suited for green manuring. Cowpeas have served the same purpose in the South. In the sub-humid region cowpeas and alfalfa give good results. In semi-arid sections alfalfa will be the best crop for the purpose if sufficient moisture to sustain the crop for a few years can be secured. An annual crop, however, will generally be most successful as a nitrogen gatherer. Cowpeas are a promising crop for this purpose, as they stand drought well. Cured as hay they make good feed, if the crop cannot be spared for green manure, and the stubble and roots by their decay add both nitrogen and humus to the soil. It is a common practice in the South to plant cowpeas between the corn rows when the last cultivation is given the corn. The long season and the moist climate mature a crop of peas from this planting. During unusually wet seasons the same practice might be followed in the semi-arid regions, letting the land lie idle the next year and giving it thorough summer tillage. However, the corn and the peas together may require so much water that each would interfere with the other. The plan should be first tried on an experimental scale only.

When wheat is grown in alternate years, advantage may be taken of an unusually wet summer to grow a green-manure crop after the wheat is harvested. Immediately after harvest put the crop, cowpeas, in the stubble ground after having thoroughly disked it. Plow the crop under just before killing frost and pack and settle the soil. Give it thorough summer tillage the next season and plant to wheat the following fall.

By taking advantage of seasons and conditions of cropping, the organic matter and the nitrogen of soils may be maintained without serious hindrance to the system of cropping, whatever that may be. But plans should be made so that each field may bear a nitrogen-gathering crop every few years. Cultivated crops should also form a part of the system for each field. They do not deplete the soil of moisture as small-grain crops do. Wheat after wheat keeps the soil continuously drier than corn after corn, or even an alternation of corn and wheat.

The desirable succession of crops can be best secured by adopting definite rotations. The particular crops must be determined upon by local conditions, but the system or rotation must include legumes, cultivated crops or fallow, and grain crops.

SUMMARY.

A deep soil of good tilth will absorb and hold for the use of plants a large part of the rainfall. Such soil is in good condition for the growth of common crops.

Soils can be put in the best of tilth, when in proper state of moisture, by deep plowing, disking, and harrowing.

Evaporation from soils can be lessened by covering them with mulch. The best mulch and the only practicable one on a large scale is a soil mulch. This can be produced and maintained by surface cultivation. To be most effective, the cultivation must be repeated after rains that puddle the surface soil. To reduce the labor of frequent cultivation, implements that cover a large surface may be employed.

In semi-arid regions special effort should be made to utilize the rainfall. The ground should be plowed soon after the removal of a previous crop; it should then be settled and smoothed. By frequent cultivation of fallow land, moisture may be stored for a crop the next year. In this way crops have been grown in semi-arid regions once in two years when crops every year on the same land have failed.

Organic matter should be maintained in soils to improve their physical condition. This may be accomplished by green manuring, and by the plowing in of manure, straw, stalks, and other vegetable refuse.

Leguminous crops, such as clover, alfalfa, and cowpeas, used as green manure, not only increase the humus of soils but supply nitrogen from the air. This is the cheapest way of adding this important fertilizer ingredient—*Farmer's Bulletin No.* 266.

FEED AND MANURE.

The reader will have noticed by this time that the writer believes it it possible to maintain the fertility of the soil and still keep that soil producing crops. This may be done by growing leguminous crops in rotation with other crops and keeping on the farm enough animals to consume all the forage produced on the farm. The farmer will realize as great or greater profit by selling the increase and products of the animals than he would realize by selling the grain and forage produced on the farm. The manure of the animals and the growing of legumes will return practically as much fertility to the soil as was removed by the crops grown on the farm.

To make the return, of course, the manure voided by the animals must be returned to the soil. If any of it is lost the soil will not get the full return. This return can be best made by applying the manure when it is as nearly fresh as possible. This can be best done by having the cattle on the pastures and rotating the pastures, as well as the crops, from one part of the farm to another, till all the farm has been covered. This being true, it is logical to conclude that the better the manure voided by the animal, the more fertility there will be returned to the soil by the manure. If the manure contains considerable plant food and it is returned to the soil before it has lost any of that plant food, then the soil will receive considerable plant food. On the other hand, if the manure contains but little plant food, even if it is applied before it has lost any of its plant food, the soil will receive but little plant food when the application is made. This leads us to ask if it is possible for some manures to be richer in plant food than others and what causes the difference.

INFLUENCE ON MANURE

Analyses show that there is a difference in the amount of fertilizing elements continued in manure. The manure of one class of animals is richer than the manure of another class. It is even found that there is a difference between individuals of the same class. One herd of cattle will void manure much richer than another herd. One team of horses will void manure much richer in the plant food needed by the soil than another team. The two teams may be of the same breed and of equal flesh and appearance, yet the manure voided by one team will be more valuable, when applied to the soil, than the manure of the other. There is a reason for this difference and generally the farmer is responsible for the difference between individuals of the same class.

There are several things which are responsible for the difference between the fertilizing constituents of manure. First, the annual. The horse voids a manure which as a rule, is richer in nitrogen and potash than the manure voided by the cow. The cow's manure is usually richer in phosphoric acid than the manure voided by the horse. We will see why this is a little later. The manure of the hog is almost twice as rich in nitrogen as the manure of the cow, but it is not nearly so rich in potash as the manure of the cow. The manure of fowls is much richer in all of the plant foods than the manure of any other animals. When cow manure is worth $2 per ton as a fertilizer, the manure of hens is worth a little over $7 per ton.

Taking $2 per ton as the comparative value of the manure of cows, a ton of sheep manure would be worth $3.30; hog manure, $3.30; horse manure, $2.25, and hen manure, $7.70. The reason for this difference lies in the fact that habits of the animals are different. They eat different food, eat more or less of one certain food, drink more or less of water. The reason for the difference of individuals lies in the fact that one animal gets more and better food than another and drinks more or less water than the other individual.

While the manure of the cow is worth less per ton than the manure of any other animal on the farm, the cow is the most valuable manure producer of any animal usually kept upon the farm. She produces so much more manure than any other animal that, in reality, in a year she voids more pounds of plant food than any other animal. Taking $2 per ton as the value of her manure and figuring the value of other animals in the proportion given above, the cow will void in a year about $26 worth of manure, while the horse will void only about $20, the hog about $5.50, and the sheep about $2.75. Hence the cow is the most valuable as a manure producer, because she produces a larger amount of manure.

Second, the age of the animal influences the value of manure. It has been found that rapidly growing animals will void as low as 50 per cent. of the amount of plant food contained in the feed fed them. Milch cows will void as high as 85 per cent. of the plant food fed in the feed; fattening and working animals, as high as 95 per cent.; while mature and old animals void practically all the plant food content of the feed consumed.

Third, the amount of water consumed by the animal also influences the value of manure. Some animals will consume more water than others, and the manure will differ accordingly. This is the reason of the concentrated manure of sheep and goats—they drink sparingly of water. Cows' manure is not so rich because they drink considerable water.

Fourth, the care animals receive and their condition influence the amount of plant food elements in the manure. The cow in a poor condition, sheltered on the south side of a fallen-down straw stack, cannot void as rich manure as the animal that is in good flesh and is sheltered in a warm stable.

Fifth, animals giving milk or producing wool will not void as rich manure as animals that do not have to supply the demands of these. It takes certain of the plant food elements to produce the milk and wool and these elements will be taken from the food consumed. Whereas, if they are not giving milk or producing wool the elements needed to supply these demands will not be needed and they will be voided in the manure. The same is true of growing animals. They are increasing and need phosphorus to make bone and nitrogen and potash in other parts of the body and more of these elements are needed than when the animal is matured.

All of the above may be considered as secondary things which influence the value of manure.

INFLUENCE OF FEED.

Feed, more than any other thing, influences the value of manure. We might call it the primary thing which influences the value of barnyard manure. If the animal is fed rich feed it will void richer manure than the animal fed poor feed. The animal that is fed corn, clover, hay and oil cake will void a much richer manure than the animal that gets nothing but musty straw and half-cured fodder. Some feeds contain more of one plant food than another and if that certain feed is fed the manure voided by the animal to which it is fed will be richer in that plant food than if some other feed had been fed. Clover is rich in nitrogen, while straw is not. Every farmer knows that if clover is fed to the animals the manure will be richer in nitrogen than it would be if straw had been fed. Bran is rich in phosphorus. If bran is fed to the stock the manure will be richer in phosphoric acid than it would be if corn meal had been fed.

A ton of clover contains 40 pounds of nitrogen, 11 pounds of phosphoric acid and 36 pounds of potash. A ton of wheat straw contains about 6 pounds of nitrogen, 5 pounds of phosphoric acid and 15 pounds of potash. It is reasonable to suppose that the manure of the clover-fed animal will be four or five times as rich in potash as the manure from straw-fed stock. A ton of wheat bran contains about 44 pounds of nitrogen, 64 pounds of phosphoric acid and 28 pounds of potash. There is nearly as much phosphoric acid in bran as there is of both nitrogen and potash. A ton of linseed meal contains 105 pounds of nitrogen, 32 pounds of phosphoric acid and 25 pounds of potash. The phosphoric acid content of the linseed meal is only about a fourth as much as the amount of nitrogen and potash. To build up the supply of phosphoric acid in the soil as compared with the other plant foods, bran is nearly four times better than linseed meal when fed to stock. This shows us that some feeds have more nitrogen than others, some contain more phosphoric acid than others and some feeds contain more potash than others. If the soil needs any one of these elements it can be seen that the sensible way to supply those needs is to feed to the animals kept on the farm the feed that contains the most of the element needed by the soil. Of the nine principal feeds most frequently used on the average farm, the Cornell station has figured out that for each ton of corn meal there is $5.66 worth of nitrogen, phosphorus and potash contained; corn fodder, $1.24; clover hay, $8.95; gluten meal, $16.75; linseed meal, nearly $21; timothy hay, $4.80; wheat bran, $13.08; oats, $7.40, and wheat straw, $2.22.

If the soil needs nitrogen, that is, if the crops make an inferior growth and the soil begins to show signs of decline, the farmer should feed feeds that contain the most nitrogen. Clover hay, oats chop and as much linseed meal or cotton seed meal as is needed to balance the ration, should be fed to the animals kept on the farm. Since the mature animals void practically all of these plant foods contained in the food, it can be seen how the soil will be benefited. If the farmer whose farm needs nitrogen, feeds his stock wheat straw, corn fodder or silage, it can be seen that but very little nitrogen will be given the manure. Alfalfa hay, cowpea forage, all of the clovers, malt sprouts, barley, tankage, are all more or less rich in nitrogen and should be fed whenever possible to animals kept on soils that need nitrogen.

If the soil needs phosphorus, the farmer should feed more bran. In every ton of bran there is nearly $5 worth of phosphoric acid. If the bran is fed to mature animals and the manure applied before it has lost any of this element by leaching, the soil will receive practically the same benefit it would if $4 or $5 worth of phosphates had been applied. The bran is even better than the phosphates because it pays its cost as a feed and the manure costs the farmer practically nothing, while the phosphates have no value other than as a plant food. If the farmer feeds timothy hay, corn and gluten, he cannot hope to return but a very little phosphoric acid to the soil in the manure of the animals fed these feeds.

But if the soil should need potash, then timothy hay should be taken largely into the ration. Corn silage, oats chop and cotton seed meal or linseed meal will not return much potash to the soil.

Besides clover, wheat straw, wheat bran and linseed meal, given above, cotton seed meal contains per ton, 136 pounds of nitrogen, 56 pounds of phosphoric acid and 30 pounds of potash. Oats grain contains 37 pounds nitrogen, 12 pounds of phosphoric acid and 9 pounds of potash per ton. Barley contains 40 pounds of nitrogen, 15 pounds phosphoric acid and 10 pounds of potash per ton. Corn grain contains 32 pounds of nitrogen, 11 pounds phosphoric acid and 7 pounds potash per ton. Oats straw contains 10 pounds of nitrogen, 5 pounds phosphoric acid and 20 pounds potash per ton. Corn silage contains about 5 pounds nitrogen, 2 pounds phosphoric acid and 7 pounds potash per ton. Timothy hay contains, perhaps, 20 pounds of nitrogen, 6 pounds of phosphoric acid and 35 pounds of potash per ton.

The above will give the reader some idea of how feed may influence the plant food content of the manure voided by the animals to which the feed has been fed. The feed is of more importance than the age of the animal. By feeding a certain feed to a young animal you can produce a richer manure than by feeding inferior feeds to a mature animal. Suppose that your soil needs nitrogen and you have young stock that voids only 65 per cent. of the plant food elements consumed. By feeding ten tons of clover and a ton of cotton-seed meal, you may expect to receive 300 pounds of nitrogen in the manure voided by the young stock. But suppose you have mature stock that void practically all of the plant food elements contained in the feed and you feed them ten tons of wheat straw and a ton of corn. You cannot hope to receive over 100 pounds of nitrogen in the manure if every pound contained in the feed was voided in the manure.

If the soil needs phosphoric acid, the same is true. If you feed two tons of bran to young stock you may expect to receive at least 80 pounds of phosphoric acid in the manure. If you feed two tons of oats grain to mature stock you could not hope to receive from the manure produced by the oats more than 24 pounds of phosphoric acid if every pound of the phosphoric acid contained in the oats was voided in the manure.

Thus we see that feed influences the amount of plant food in the manure more than any other thing. If the feed is rich in any plant food or plant foods, it is safe to conclude that the manure produced by the animals to which that feed was fed will also be rich in that plant food or those plant foods.—*W. E. Sherlock.*

MANURE NEEDED FOR CROPS.

Amount of barn-yard manure required to replace the plant-food abstracted from the soil by an acre of—

Wheat	5	tons	manure.
Oats	5	"	"
Meadow hay	6	"	"
Clover	10	"	"
Beans	10	"	"
Marigolds	20	"	"
Potatoes	10	"	"
Cabbage	20	"	"

The rainfall during the year carries down about five pounds per acre of ammonia in the county districts; if near large cities it is much greater, for around Manchester, England, it is thirty-six pounds, and near Glasgow, Scotland, it is fifty pounds.

The horses rest while the man does the work.

The team spread the manure while the man rests.

Ammonia is worth sixteen cents per pound. One foot of snow brings to the soil about three pounds of ammonia.

FARMERS OWN EXPERIMENTS.

It will pay each farmer to test for himself the fertilizer requirements of his own farm, and for this purpose some simple and easy experiments should be carried out. As easy mode is to select, say seven plats or strips of land in a field, and number them from one to seven. Sow on number

1. Nitrogen with the crop.
2. Nitrogen and phosphoric acid.
3. Nitrogen and potash.
4. Nitrogen, phosphoric acid and potash.
5. Potash.
6. Phosphoric acid.
7. No fertilizer.

It is necessary to leave one plat with no fertilizer, for purposes of comparison, and a number of trials can be made in this manner. This plan does not interfere with the ordinary work of the crop in the field, but will give the farmer a vast deal of information, that he cannot get in any other way, as to what ingredients his land needs for the different crops he may desire to grow.

STUDY THE SOIL.

Every farmer should try to make a yearly improvement in his practice, for without improvement in methods there will be no increase in profits. Let the soil be made a little better every year, and the corresponding increase in the yield of products will compensate three or four times the outlay. On the other hand, if there is a constant decrease in the fertility of the soil, the ability of the farmer to improve his soil by reason of the decreased yield in his crops will keep him on the downward path. Study the soil; keep it in good heart by rotation, clovering and manuring, and success is inevitable. These are the keys with which to unlock the farmer's treasure box.

GERMAN CLOVER AND CORN FOR EIGHT YEARS.

Prior to eight years ago I grew German clover in a limited way and discovered its great value as a nitrogen gatherer and land improver. I began experimenting, in an extended way, with it eights years ago, when I began with about twenty acres of thin upland that would not produce, at the time of beginning, more than two or two and a half barrels of corn per acre, a good year.

I planted this corn, after making fairly good preparation, worked level—that is, with five tooth cultivators, and in July and August, when we went to give it the last working, I sowed a small quantity of animal bone—say 200 pounds to the acre—broad-cast and about fifteen pounds of crimson clover seed broad-cast, sowing two rows at a time in front of the cultivators, the cultivators doing the last working and getting in the seed at the same time. I used the bone because the land was too poor to start German clover. The corn was shocked as usual. The next spring we had a fairly good crop of clover. Part was cut and cured for hay and part was turned under and the land put in corn again, using about a hundred pounds of bone in the corn planter at time of planting. Then clover was seeded again in August, at the last working, and each spring we have cut off the greater proportion of the clover for hay and have continued to put this land in corn for eight successive years, the crop increasing in quality and in quantity. Last year we got eight or ten barrels per acre, and this land was so much improved by continuous clover that we decided, the past spring, to put the majority of it into permament grass land and a portion of it in alfalfa.

About six acres of it was put in German millet and made the heaviest crop of millet we ever grew on any land. The present year we took up new land, concluding that we would improve twenty or twenty-five acres of fresh land, and in a few years we will get over our entire farm.

We have had fine success taking ordinary land—say the first of September—mowing all the weeds, putting them in farm pen for litter, disking the land, where it had not been plowed for several years, sowing the German clover and dragging the seed in. In this way we have also been very successful producing heavy crops of peas and other things after German clover has been cut off or grazed. I believe any land in this section can be readily improved by the use of German clover and brought up to a high state of productiveness. It is my conviction that even when the clover is cut off for hay that the plant has deposited from twelve to twenty dollars' worth of nitrogen in the soil, per acre.

Farmers Listening to the Lecture in the Railway Car in Piedmont, Virginia.

There is some prejudice against crimson clover hay, but after ten years' experience I believe it is equal to any hay we grow, even as good as alfalfa. We usually cut in May, and have frequently fed our work animals with it from six to eight months continually, and as soon as we stopped feeding crimson clover our animals did not keep in as good condition on any other hay.

Crimson clover hay is rich in oil, and in this respect is like heavy tobacco and absorbs moisture freely, in damp weather, and if not put into a house or covered with some other hay to exclude the air it is apt to mildew on the outside the first spell of damp weather following the housing, but if well dried in the field, put in a close house or, if in an open house, covered with any material that will prevent the air reaching it too freely it will not mould and is the richest hay for feeding we know. It has never produced a case of heaves with any of our horses or mules, if cut when in bloom. We would not advise cutting it as hay after it has matured seed on any portion of it.

There are two varieties of German clover—one crimson, which matures very early. The other variety is called white German clover, and matures two or three weeks later—when the days are longer and the sun has more power to cure the hay properly. We are making a large portion of our seeding now with the white bloom, so as to cut the hay. We said above that on portion of the land we cut the clover for hay and on portion we turned it under for fallow. We see no preceptible advantage in turning it under. In fact, after turning it under for several years the land got rather too porous and the corn did not do so well as where the hay was taken off.

For the first few years after we began this experiment we had some difficulty in getting a variety of white corn that would ripen as late as it was necessary to plant to follow German clover, as frequently we would have a dry spell after the clover was cut and would be unable to plow the land for several weeks. I determined to breed up a variety of corn to meet this contingency. I started seven years ago by mixing three bushels of Cocke's Prolific and three bushels of a large gourd seed variety with the desire to get the two blended, as I wanted a prolific corn and one that would ripen early. Each fall since, at time of harvesting, I have taken a man through the field, in front of the harvesters, and selected fully ripe stalks that had not less than two good ears. These were taken out and shocked to themselves, and from this picking I have selected my seed for six years, until now I have a prolific white corn that will mature planted as late as the fourth or sixth of July.

I am satisfied that nothing will pay Virginia farmers, especially those in eastern and middle Virginia, so good returns and get their farms improved so rapidly as crimson clover—*J. B Watkins, Midlothian, Va.*

FERTILIZING VALUE OF DIFFERENT PHOSPHATES.

A previous bulletin of this series contained an article on this subject in which the following statement was made:

"The different phosphates used in fertilizers differ widely in availability. i. e., in the readiness with which they are taken up by plants, and different plants have been found to vary greatly in their capacity to assimilate the phosphoric acid of a given phosphate. The insoluble phosphates are much cheaper than the soluble forms. Phosphoric acid in soluble form costs in the market from 4 to 6 cents per pound (often more in mixed fertilizers), while that of the crude mineral phosphates is worth less than 2 cents per pound. If, therefore, it can be shown that certain plants can utilize some of the insoluble phosphates to good advantage the outlay for phosphates may be greatly reduced."

Experiments made by the Maine Experiment Station were cited in the article containing this statement, which indicated that with certain kinds of plants, notably turnips and ruta-bagas, crude fine-ground Florida rock phosphate (floats) was utilized to good advantage at all stages of growth as a source of phosphoric acid. Other crops, such as corn, barley, clover, tomatoes, and potatoes, did not respond to applications of the insoluble phosphates in the earlier stages of growth, but utilized it to better advantage in later stages of growth, thus suggesting "that it may be profitable on certain crops grown on a large scale to combine the soluble and insoluble phosphates, applying a small amount of the former at time of planting to hasten the early growth of the crop, and a larger amount of the latter a few weeks later to supply the wants of the more advanced plants. In this way the outlay for phosphoric acid would be greatly reduced and probably the yield in no way decreased."

The fertilizing value of the insoluble phosphates, such as crude fine-ground Florida or Tennessee rock phosphate, as compared with the more soluble and readily available forms of phosphoric acid, such as acid phosphate, Thomas slag, etc., has been carefully investigated in recent years by a number of other experiment stations, particularly those of Illinois, Maryland, Massachusetts, and Ohio, and, while the results have not been entirely conclusive, they in general bear out those obtained by the Maine Station, and indicate that such phosphates may in many cases profitably replace to a large extent the more expensive phosphates, particularly on soils naturally or artificially supplied with an abundance of decaying organic matter (humus) and with certain kinds of crops, especially those having a long season of growth and with which early maturity is not an important consideration. On the other hand, crops which must be forced in their early stages of growth and brought to early maturity require more soluble forms of phosphoric acid.

Experiments made by a number of eastern experiment stations show rather conclusively that the insoluble phosphates cannot be profitably used, for example, in market gardening on the light soils best adapted to that purpose, while it has been clearly demonstrated by several of the southern and western experiment stations that, when used in connection with liberal applications of stable manure or green manures, the cheap insoluble phosphates are about as effective and much more economical in general farming than the high-priced acid phosphates. The use of fine-ground phosphates or floats in connection with green manures, cotton-seed meal, and other organic matter, the decomposition of which in the soil is believed to render the phosphoric acid more available, has long been practiced in the South, and the advantages of the practice have been demonstrated by the Alabama Experiment Station.

The more recent experiments of the Ohio Station showed that when fine-ground rock phosphate (floats) was sprinkled on barnyard manure at the rate of 40 pounds per ton of manure it not only acted as a preventive of loss of nitrogen, but was itself improved in availability. The floats were apparently as effective as gypsum and kainit in preventing loss of nitrogen, and at the same time re-enforced the manure in a constituent (phosphoric acid) in which it is usually deficient. C. G. Hopkins shows that as an average of 42 different tests by the Ohio Station, extending over a period of seven years, "the average value of farm manure was found to be $1.99 per ton, measured in increased crop yields produced, but when 40 pounds of finely ground rock phosphate were added to the ton of manure, its average value was found to be $3.23 per ton, making an increased value, due to the addition of the phosphorus, of $1.24 per ton of manure."

The 40 pounds of rock phosphate used cost about 16 cents, thus showing a net profit of $1.08 for every ton of manure with which the phosphate was mixed.

"The 16 cents' worth of raw rock phosphate produced almost as large an increase in the crop yields as 30 cents' worth of ordinary acid phosphate, the use of which gave an added net return of $1.18 for each ton of manure with which the acid phosphate was mixed. As an average of 42 tests with each material, $1 invested in raw rock phosphate made a net profit of $6.75, and $1 invested in acid phosphate made a net profit of $3.93. Futhermore, the 40 pounds of untreated rock phosphate enriches the soil in phosphorus twice as much as the 40 pounds of acid phosphate; consequently, in the long run, the untreated rock phosphate must produce the more lasting results."

In order that the manure may exert its full effect in rendering the phosphoric acid more available, the floats should be kept in contact with the manure as long as possible. This is best accomplished by sprinkling the floats over the manure as it is produced from day to day. Doctor Hopkins advises the use of 100 pounds of finely ground rock phosphate to each ton of manure.

Experiments with different phosphates as the Maryland Experiment Station, extending over a number of years and including a variety of crops—corn, wheat, hay, crimson clover, etc.—showed that the insoluble phosphates gave greater total product for a series of years than the soluble phosphates and at about one-half the cost of the latter. The best results were obtained with the insoluble phosphates when the soil was well filled with organic matter, the most efficient of the means of effecting this tested in these experiments being the use of crimson clover as a green manure.

In a series of four-year rotations of wheat, grass (timothy and clover), corn, and oats, at the Pennsylvania Experiment Station it was found that ground steamed bone (which contains phosphoric acid in insoluble form) gave better results than dissolved boneblack in case of corn and that its residual effect was greater in all cases.

Doctor Hopkins has summed up the results of his own experiments at the Illinois Station with insoluble phosphates and those of the Maryland and Ohio stations as follows:

"Before we had begun the general investigation of Illinois soils, Patterson had some good evidence that when turned under with crimson clover raw rock phosphate is as valuable as bone meal, and Thorne had demonstrated that when used in intimate connection with farm manure rock phosphate is much more profitable than acid phosphate on the basis of money invested. * * *

"The Illinois experiments with rock phosphate, although extensive in scope, were begun too recently to afford much data. It may be stated, however, that where we have used finely ground natural rock phosphate in direct comparison with equal money values of steamed bone meal, both being applied in connection with decaying organic matter, we have thus far obtained a larger average increase with the rock phosphate.

"So far as I can learn, whoever has persistently tried the use of liberal amounts of finely ground rock phosphate, in connection with abundance of decaying organic matter, has obtained results beyond his expectations. * * *

"Why should we pay $80 for 4 tons of "complete fertilizer," or even $30 for 2 tons of acid phosphate, for the same amount of phosphorus as we can buy for $8 in 1 ton of finely ground natural rock phosphate? Some will answer that the raw rock is not readily available. This is true; but it is also true that is is the business of the farmer to make it available by means of decaying organic matter, the same means by which he makes available the insoluble potassium and the raw rock phosphate naturally contained in the soil."

As regards methods of using rock phosphate, Doctor Hopkins makes the following recommendations:

"The phosphate may be scattered over the manure from day to day as the manure is being made in the stable or in the feed lot; indeed, this appears to be the ideal method of using it; or, when loading the manure onto the manure spreader from the yard or stall, the spreader box may be loaded half full, then 100 pounds of rock phosphate scattered over the manure as uniformly as possible, and after completing the load of manure it may be hauled to the field and spread.

"If farm manure is not available, then I advise applying from 1,000 to 2,000 pounds of finely ground rock phosphate per acre every three to six years, depending upon the length of the rotation. In this case the phosphate should be applied to clover sod or a catch crop of cowpeas, soy beans, etc., and plowed under with as much organic matter as practicable. With a three-year rotation of corn, wheat, and clover, or corn, oats, and clover, 1,000 pounds of rock phosphate may be applied to the clover sod and turned under, preferably in connection with the second crop of clover, which often is worth more to turn under than it is to cut for seed. With a six-year rotation of corn, oats, wheat, clover, timothy, and pasture, 1 ton per acre of rock phosphate may be applied to the pasture ground in connection with farm manure and plowed under for corn, preferably with a considerable growth of grass and clover."

In general, we may say that soluble phosphates like acid phosphate are more expensive than the insoluble phosphate, fine-ground Florida or Tennessee phosphate, but quicker in action and thus better suited to short-season, high-value crops which it is desirable to force to early maturity, such as are grown in market gardening. For the long-season crops, usually grown in general farming, and for cruciferous plants, such as turnips, cabbage, etc., the insoluble phosphates may prove fully as effective and much more economical than the acid phosphates, particularly if used on soils naturally well stocked with humus, or in connection with barnyard manure or green manures. The insouble phosphates also give better results when used on moist clay soils rather than on dry sandy soils and applied in connection with soluble fertilizing materials such as ammonium sulphate and potash salts.—*U. S. Bulletin No.* 262.

CARE IN SELECTION OF SEED.

Farmers should be careful in the selection of their seed of all kinds. It is best to select the seed from the best portion of the field, where the grains have well ripened, and use only the heaviest grain, well fanned out.

In this way the quality of the grain will be constantly improving. It will pay any farmer to give this matter careful attention every year.

LIMING LAND.

Lime shows test effects on land that contains clay or contains vegetable matter. Frequently small doses of a few hundred pounds of ground rock lime per acre shows the best results. On sandy land marl shows beneficial results. Lime should not be used with any commercial fertilizer, or with stable manure, unless plowed under immediately, so that the soil will hold the nitrogen that is set free by the action of the lime. Soil that contains over 4 per cent. of lime should not have any applied, as a rule. The blue litmus paper test will show whether the soil is deficient in lime. Past reports have explained how to apply the litmus paper.

Lime also unites with felspar or clay, setting free potash or other alkalies. Also renders harmless injurious salts of copper, iron, etc. Air-slacked lime of long exposure is about the same as ground limestone rock.

"Lime and lime without manure
Will make both farm and farmer poor."

Ready to Spread Lime on Pea Stubble.

LIME TABLE.

Sowing distances apart that one bushel and one-half bushel piles lime should be placed to cover an acre with a given quantity. Quick-ne weights 70 pounds to the bushel. Air-slaked lime weighs 50 unds to the bushel.

	One Bus. Piles	Half Bus. Piles
	No. Feet Square.	
put 20 bushels per acre	46½	33
" 25 " "	41¾	29½
" 30 " "	38	27
" 40 " "	33	23¼
" 50 " "	29½	20¾
" 60 " "	27	19
" 70 " "	25	17¾
" 75 " "	24¼	17
" 80 " "	23½	16½
" 90 " "	22	15½
" 100 " "	20¾	14¾

When lime is put out in this way, it should never be allowed to lay ıtil it becomes "mucked" or spread when it is wet.

TEST FOR ACID SOILS.

The best single test for determining soil acidity which is capable of ing used by persons upon their own farms is that with blue litmus per. Such paper can be bought of an apothecary at trifling cost. rips half an inch wide and two inches long are convenient for making e tests. Care should be taken not to handle the end of the paper at is to be inserted in the soil, for if the fingers are moist they will dden the paper so that it will appear much as it does when reddened acid soil. The soil to be tested should then be moistened sufficiently th water to make a thick paste and should then be allowed to stand for lf an hour or longer. It may then be parted by the use of a knife ade or other convenient instrument, and after introducing one end of e litmus paper the soil should be pressed against the sides of the per. After from half an hour to an hour the paper may be removed om the soil, taking care not to tear it. After its removal the paper may be dipped repeatedly in water in order to wash off the adhering soil. If a distinct red color has entirely taken the place of the original blue color of the paper, it may be concluded that the soil probably needs liming.

In the case of very red soils it is often better to press the blue litmus paper against the soil than to have it surrounded by it. If in such cases the blue color of the paper disappears and gives place to a distinct red one, acidity is indicated. This blue litmus paper test furnishes also a good means for testing for acidity in subsoils, or soils very deficient in organic matter, where the acid substances may be largely of mineral origin. A good supplementary test, which is applicable only in soils containing considerable humus, is made by means of adding dilute ammonia water to soils. Ammonia, too, can be bought of an apothecary at slight expense. In making this test take two glasses, place a level tablespoonful of soil in each, then add water until the glasses are about two-thirds full. Now add a tablespoonful of diluted ammonia water to one of the glasses. Stir each with a different spoon or knife. If, after standing some hours, the liquid in the one to which the ammonia water was added has become dark brown or black, it may be concluded that acid humus was probably present and hence that liming will prove helpful.

SPECIALISM ON THE FARM.

This is an age of specialism. The time was when the shoemaker, or cobbler as he was called, made our boots and shoes as the case might be wholly himself. To-day there are 68 persons employed in the manufacture of a single shoe, each having but one thing to do. The same may be said of the manufacturer of watches, wagons, farm machinery and so on all along the line. While farm work cannot, of course, be divided up so minutely as can the manufacture of merchandise or machinery, there is no reason why special lines cannot be taken up on the farm, and one become an expert in the line of stock he breeds or the special line of produce he grows.

Indians carried on agriculture in a primitive and a very limited way in the region now embraced in the United States before the country was inhabited by the white race, next came the white man. Poor in the materials of wealth, indeed almost destitute of them, a stranger in a strange land with a strange climate he had in prospect a simple subsistance upon the few products of crude agriculture. He saw the golden ears of corn hanging in the wigwams of the Indians and learned its value as good. Even as far back as 1790 there was in a manner some specialism in farming; for at this time the state of Georgia made a specialty of producing tobacco. It was cultivated in the simplest manner with the rudest of tools. Agriculture, as we now know it, can hardly be considered to have existed. The plow was very little used. A crude hoe was the implement of industry. It was almost invariably true of all the old settlers that the use and value of manures was little regarded. The barn was sometimes removed to get it out of the way of the heaps of manure. In comparison with present conditions, the farmer's life in those days was a dreary one, filled with hardships and deprivations, treading very closely upon the margin of subsistence. These conditions continued until well into the past century or until an improved intelligent dissemination of information and work of the inventor had begun to take effect, this was, of course, in the days of the old time farmer of which we see too many even at present time. You have all seen him and know his methods well. He believes he knows all about farming and always has from the time he came on earth. He never attends a live stock breeders meeting or a farmer's institute. Oh, no! He does not want any high-toned methods or book farming in his, neither does he believe agricultural papers. It has been a hard thing for him to even use any improved farm machinery. It was many years before he would try a corn planter, believing corn should be planted by hand in a furrow made by a horse hitched to an old-fashioned bull-tongue plow. The corn dropped into the furrow and covered with a hoe. He thinks a seeder or drill too expensive and that he can sow his grain from an old sack thrown over his shoulder and will tramp all day in the soft-plowed field that has not even been harrowed, carrying his load and poorly scattering the seed, while his young son drives a dilapidated old-team,—possibly one horse and one mule,—hitched to an old fashioned "A" harrow containing about 25 or 30 teeth. He will get up in the morning about four o'clock and commence by a series of yells to raise every one in the house—if they are not dead—no doubt some of them wished they were. He then takes a chew of navy plug and starts for the barnyard, and feels his way about in the dark to find the basket to carry a little mouldy corn and throw it over the rail fence into the mud for the hogs, which are too sleepy even in their unsheltered muddy pen to get up and hunt for it. Anything is good enough for a hog in his estimation. By this time the boy comes shambling along trying to get his eyes open, and thinks of the day when he will be his own boss and can leave the farm.

The old man meanders about the straw pile in the dark, kicking up the cattle until he finds the old bridle cow, and then proceeds to coax a little milk from her, while the boy throws a few ears of corn to the horses and puts the "gears" on ready for the day's grind. The cattle, horses, pigs and chickens are all scrubs and so is the owner. Thus, he goes on year after year, raising poor crops, never making any improvements, and really thinking that he is a farmer. He is generally found two or three times a week on a box at the door of the village store chewing his plug of tobacco and discussing the tariff, and finding fault with every one and everything in general, vowing that the government should legislate for the farmer.

I might go on and describe to you how this farmer raises his family, but you all know, so it would be a waste of time.

We next come to another kind of a farmer of which there are more than of any other kind. He generally has a very good farm, possibly inherited from his father, or if he be an old settler he probably got his land from the government for practically nothing. This man has worked early and late, has been very economical, has a comfortable home, fair buildings and considerable live stock of an ordinary grade, sometimes used good sires, and improved machinery, but generally leaves the latter standing out in the weather from one season to another. He raises fair crops, sells most of his produce as raw material instead of manufacturing it into beef, pork, mutton and wool. He does, however, sell some milk and a few hogs; if he is a patron of a creamery his cows probably yield him about $35.00 per year, and he has to haul the milk from one to two or three miles to the creamery and take what they have a mind to give him for it after making the test as low as they dare to. His hogs are generally a mixed conglomeration, starting some years ago with the Magie and staying with the breed later called Poland Chinas, and inbreeding until it took twenty sows to raise fifty pigs, then he concluded a cross would be a good thing and he has tried to turn, the Chester White, Berkshire, and the Durock Jersey, until his hogs are of every known shape and color. He always sells the old sows after having one litter and breeds the young immature sows and even uses a young pig for a sire, each year finding his hogs smaller and with less vitality. As soon as new corn is in the roasting ear he moves his pigs from a dry pasture and gorges them with his green corn until they are in a condition to take any disease that comes along. He may raise a few steers, but the grade is a little mixed, and when he gets them up to what he thinks is in market condition the local buyer gets them on a good wide margin, knowing that they must go far below the top of the market when they reach Chicago. Now, all farmers that are not specialists do not farm this way, for we have many good first class farmers that are up-to-date in their methods. They live well, raise their families well, produce good crops and keep good stock, buying the best pure bred sires and feeding well. These farmers make money, generally become wealthy or in good circumstances and are good useful citizens, yet too many of them finally rent their farms and move to town, the result is the farm soon begins to have a run down appearance. They spend their income from the farm in the town or city, build a nice home and get—what they suppose—ready to enjoy life, but do they really enjoy the town? Used as they have been to the farm, it is hard for them to sit idle. They cannot, if in a city or large town feel much at home, generally they do not mix well with the city people, and they eke out a lonely existence. Sometimes they try merchandising, but this is nearly always a failure. How much better had they remained on the farm, build a modern home, a nice barn and out buildings, made a nice lawn and kept it in nice shape and condition, stopped their hard work and put in the remainder of their days overseeing the farm and stock and keeping everything up in ship shape. If every farmer in this state who is able to move to the city and build him a new home and stay on his farm and spend the same amount of money in improvements that he would in the city, this would be the most beautiful state in the Union and the Garden spot of America.

The old saying that one should not carry all his eggs in one basket, or that we should practice diversified farming may possibly be best, but there is another old adage which is also true: "Time changes all things, and this is an age of specialism and concentration of thoughts and ideas along one line, either in manufacturing, commerce, farming or stock breeding, which will result in a large business being built up and a reputation established for whatever is manufactured or produced. If manufactures can build up a large business by giving special attention to one or two lines, why cannot a farmer by making a speciality of some one or two things become an expert in these and also build a large business and a lasting reputation that will command a market and a good price for all he produces, either in the growing of grain for seed or the breeding of live stock for the market or for the breeder.

The English farmers over a century ago took up the breeding of various breeds of pure bred cattle, sheep and swine as well as horses, and have steadily aimed at one object and that has been to produce the best of its kind or breed. In many instances they have carried this work on better than the American farmer, for the reason that they have not been lead off from their aim by any fad or fancy, but have steadily adhered to the principle of breeding the best possible individuals regardless of color or pedigree which has often been the stumbling block of American breeders. In this way they have established a reputation and a business for their special breeds throughout the world and America is their best customer even to-day.

The American farmer, the king of them all, can by concentrating his best thought and energy produce a branch of produce or improve a breed that will command the attention of the world's buyers, and will establish for himself a trade and reputation that his sons and sons' sons can, by carefully keeping it untarnished, reap the benefits. It is a long struggle, however, to build up a strong valued reputation and requires the best qualities in man to accomplish, and when accomplished the same honest, careful, painstaking methods, must be adhered to, to preserve this reputation. Reputation is a thing that can be quickly lost and once lost, is very hard to regain.

In advocating specialism on the farm, I would urge that the farmer who starts out along this line take up some speciality that is not only adapted to his farm and surroundings, but one that he is satisfied he would like to work out, for unless he loves his speciality he will not succeed. After he has decided what he will take up let him study and endeavor to produce the best possible of its kind, he can thus cater to the highest class of buyers. There are always men who want the best and are willing to pay for it. Much farming lands have become too high-priced to admit of growing anything that must be sold for an average price. The average crop of the average price will never pay anyone. It is easier to sell a high-class breeding bull for $500, $1,000 or upwards if he has the individual quality and breeding, than to sell one worth only $100. Same is true in any other kind of pure bred live stock. I have found that the best animals we can breed are easier to sell at a long price, than those that are not quite so good in quality are to sell at a low price, for the reason that the man who will only pay a small price for a sire, no matter how good he may be, does not know the value of a good sire, so I repeat, strive to produce the best possible.

If one should take up the dairy business, let him run a small creamery of his own and let his product be so choice that once it gets on the market and is appreciated it will not be long until every one is asking for his brand of dairy products, be it either butter or cheese.

Do you think for a moment that Mr. Gurler, of De Kalb, Ill., would follow dairying in a general way and do as many do, keep scrub stock, and haul the scanty supply of milk several miles to a creamery? Never! He is a specialist who puts his brains and energy into a special line of airy product, and the result is a demand at a good price for all that e can produce and a reputation for high-class goods established.

Again, do you think that our friend Kerrick would grow beef from a rub or run his farm at all if he had to raise a little of every known rop and handle a few each of several breeds of cattle? Not much; he a specialist, in other words he is a manufacturer of the raw products f his farm into high-class beef. He gives this work his best thought nd what is the result? His name is a household word wherever beef eaten, and his name is established in the markets of the world for is brand, if you please, of angus beef, always being assured of the top r above the top price in the market. The same may be said of the heep specialist, or the breeder of draft horses, or the grower of fruits, r the breeder of swine. When a fruit tree man comes to my farm nd wants me to purchase trees for an orchard, I say to him that I know othing about fruit growing. I am a hog man and we can sell one pig or enough to keep us in fruit for a year.

Even a small speciality taken up and a special effort made to produce high grade article, soon becomes an established article on the market, nd pays and pays well. In my own neighborhood the young wife of a ustling young farmer, ever ready to add to the income of the farm, and eing an expert in the manufacture of dutch cheese, took it upon herelf to offer some for sale to the best families in the near-by city. She s an educated, accomplished lady, and like her husband a hustler. The nly hard thing in the start was to have the courage to take this product to the city and offer it for sale to the best families, but once the city families got a taste of that Dutch cheese, a sure customer was secured and a trade established for the future. What was the result? The milk that had been going to the creamery from the few cows, was manufactured into Dutch cheese and about $90 per month was received in cash, instead of about one-fourth that amount.

I will sight another instance. Adjoining our farm, is a young couple living on a place containing but 12 acres of tillable land and about the same amount in pasture. It was a hard proposition to make a living unless some speciality was taken up, and two or three years ago this young man concluded to make a change in his farm methods and become a specialist, and he took up the growing of small fruits. This year he received from one acre of strawberries more money than some men receive from an 80-acre farm. I also have an acquaintance, who lives in another county in this state, who owns a 30-acre fruit farm, growing all the varieties of small fruits as well as other kinds. The man makes more clear money than many farmers, farming in a general way 500 to

1,000 acres. I know of no man who from the same effort makes more money or takes life any easier. He spends only the summer season on the farm. After the fruit crop is marketed he goes to his home in the city, and when the cold weather of winter comes on he, with his family, goes to Florida. These few instances sighted, as well as our own experience in making a specialty of swine breeding, convinces me that specialism on the farm is a success. Market prices seldom effect the specialist. No matter whether corn is 30c. or 50c. on the market, the Funk Bros. will not have to change their price on pure bred seed corn. Why? Because they have, by devoting their thought and labor to a special line of corn breeding, produced a quality of corn that is in demand over the different corn states of the union, and have built up a reputation for their brands.

In our own business, if you will pardon me for mentioning the fact, that of breeding pure bred swine as a specialty was taken up nearly 30 years ago, believing that with but a small capital and a determination to follow it as a life business, more money could be received from the farm than by general farming. Beginning in the smallest possible way and learning the business step by step and getting experience by hard knocks, only increasing our operations as we increased in this experience. The road, of course, was a long one and not strewn with roses, yet it has been followed long enough to prove to be a success, having established a trade and a demand from the best buyers of this and other counties for all that we can produce, at prices that pay us better than the marketing of the products of the farm in any other way.

Our farmers as a rule, are not careful enough regarding wasteful methods. Too much feed given or more than can be eaten with a relish is wasteful. Too little care in housing of the farm machinery is probably the most reckless waste on most farms and about the easiest remedied. More stock than can be kept well is another waste. Animals that fail to breed regularly are what might be called dead beat boarders. This is a waste. Poor tillage of the land is another waste. The selling of the raw products of the farm is another waste. It is a waste of fertility to raise timothy hay and haul it to market when you might raise clover and feed it to sheep and cattle and sell it in a condensed form as mutton. wool or beef. If the great manufacturing establishments of this country were as wasteful as we they would soon go out of business. Armour & Co., the great packers of Chicago, could not stand the loss one year if they wasted in the slaughter of each hog or other animals killed what the farmer wastes in each one that he slaughters, and this comparison might be carried on much further.

It is the wasteful methods, especially in our business, that causes much of the loss. Coming generations will farm less land and farm it much better, for it is a well known fact that the farmer of to-day tries to cultivate more land than he can till in the best manner, thereby losing much in yield. Let us farm a little more intensive instead of so extensively and try and double our present yield.

Too many look on hired help wholly as a loss, when he should look upon his help as a source of profit. A good hired man, as he is usually termed, is one that is intelligent and has his employer's interests at heart, and is worth good wages and worthy his hire. A poor one is high at any price.

It requires a man of broader intelligence to-day to work on a farm than it did fifty years ago, for he must not only be able to do a good days work, but must be capable and understand the running of all farm machinery, and many other things required of him. In fact, it requires more brains and less muscle to-day to succeed as a farmer than it did in olden times.

As this country becomes more densely populated the farms will necessarily become smaller, and more adapted to some special line. The question of keeping the boys on the farm is of vital importance, and I believe that the taking up of special lines will do much towards interesting them and will give them a chance to work out some line best suited to their talent, and they will find it a pleasant, profitable occupation.

There is still another side to specialism on the farm. It is not all a matter of dollars and cents in this life of ours. There is much in the satisfaction in producing something a little better than the average, and thus being a benefactor. The grower of high-class seed corn is a benefactor, because he enables the farmer, by using improved seeds, to grow more bushels per acre and a better quality. If a stock breeder, he is also a benefactor, by enabling the farmer to improve his stock by using pure bred sires. He is also a broader man, and gets out among his fellows, and in rubbing up against the people of the world wears off the rough edges. A man of this kind is apt to have a better home and think more of it. He not only raises a high class of produce on his farm or breeds a high class of stock, but will be very likely to raise a better family. He will make his home the most cherished spot on earth to him, and that home will be on the farm.

The rural free delivery of mail, telephone and the electric railway are doing much to make the home of the up-to-date farmer an ideal one.—*A. J. Lovejoy.*

SOME NOTES ON FARMING AND LABOR IN EUROPE.

The most important thought to the European farmer is maintaining the fertility of his soil. He saves all of the manure and applies it to the land. It is not piled under the eaves of the barn and leached by the rain. The manure is applied as soon as convenient after it is made, as a rule.

The European farmer farms less land than we do in Virginia. He does not let weeds and bushes grow in the fence rows (when they have fences), or on the ditch bank, or plow around the bushes, or leave the loose stone scattered over the fields. Every foot of land is utilized and made to produce something, either grain or grass. No weeds, never—but grass. The farms are usually very small, but some contain several hundred acres. On the small farms the grain is cut by hand. The wheat is mowed with a scythe and a woman often—with her hands (no rake)—takes up the grain and binds it into sheaves, and keeps up too. The wheat, rye and barley is heavy and the shocks are thick in the fields. The grain is hauled in usually in one-horse carts, with long awkward looking ladders. The pitcher leads the horse from place to place; but they are horses—big 1400 to 1800 pounders, and fat and sleek. (They use the curry comb.)

Much of the land is naturally inferior to some of our Virginia land, but by keeping stock and saving the manure and crop rotation it has become very valuable.

In Sweden, Denmark and Germany it is worth from $300 to $500 an acre; in Holland, $800 to $1,200, and on the Island of Jersey sometimes $2,000 an acre. The latter is trucking land, where 600 bushels of early potatoes are grown and sold in London for $1.50 to $2.00 per bushel. Except in "Jersey" the highest priced land is in the dairy districts.

In Germany and Holland farmers are making money on $1,000 (acre) land at dairying. The grain fed included oil cake (cotton-seed meal) from the Southern States. Butter sells there at 35 to 37 cents per pound, but every cow is tested, and if found below the point of profit she goes to the butcher. A competent man is employed—usually one who has attended some of the agricultural schools—who tests all of the cows for one of these associations. The farmers who compose the association may own 1,000 or more cows. So that every farmer knows the producing value of each cow in his herd. During the summer and autumn the cows are generally tethered in the pastures. Sometimes as many as seventy-five cows may be seen tethered in a row across a field, where the clover is almost waist high in front of the cattle, but the ground is bare behind them. Water is hauled to them in a tank-wagon. The cow drinks from an opening in the tank and then the wagon passes to the next cow. Once a day a man takes up the stake and moves it into the edge of the new grass and drives it into the ground. Where there are many cows a man or a boy remains in the field among the cattle to tighten any stakes that may become loose. During cold rains the cows are often blanketed. In this way many more cows may be supported upon a farm.

A balanced ration is closely followed—"every edge is made to cut." There are forty-five agricultural schools in Denmark, which is one-fifth the size of Virginia, and maintains a population of two and a half millions. The Danish farmers appear to be the most thrifty and successful in Europe—that is to say in the world.

The dairy, hogs and poultry are their principal products. The farmers of Europe must watch constantly the cost of production. Their land is high-priced, feeds are higher than here, and the selling price is but little higher than here.

CO-OPERATION OF THE FARMERS.

One of the great sources of profit to the farmers of Northern Europe is co-operation in their buying and selling. They put in their own pockets the middleman's share. They form organizations in the dairy sections and buy their feed and stock and sell their products. In the trucking sections they send their committees to market to see their stuff sold and to note any changes in the markets, the size of the packages and the demands of the trade.

Members of the French Farmers' Organizations are seen in the British markets—London, Manchester, Birmingham and all the principal markets.

Why cannot our Virginia farmers do likewise. The cotton growers have managed to keep the price of cotton up to ten cents per pound, and the tobacco growers can do as well, or better, if they would only stand together and set their price on their tobacco. The world must have their tobacco, the Trusts cannot grow it. If tobacco could be grown in Europe it would be sold by the farmers there just as they sell their potatoes and dairy products—at living prices. Let our tobacco growers throw off the yoke of bondage and sell their tobacco at a fair profit. The truckers on the Eastern Shore are doing this. The past year they did nearly $2,000,000 business. The fruit growers and peanut growers can do the same. The success of the produce exchange has increased the profits to the farmers; it has advanced the price of land on the Eastern Shore, and all kinds of business has been stimulated.

FARM LABOR.

The farm labor in Europe are trained to do faithful work. What they do they do well, and do it so all the time, they are honest and reliable as a rule.

The domestic help are most faithful and energetic. What a contrast to the slipshod negro labor we have worried with in Virginia. A gentleman in Richmond procured a Scotch cook, through the Department of Agriculture, at $15.00 per month, including board and lodging. This gentleman reports that his first month's grocery bill was $6.00 less than formerly. This domestic did the washing for his family, which saved him another $6.00. He noticed also quite a saving in his coal, and on the whole he considers he is paying really about $2.00 per month, and has infinitely more satisfaction in the work done. These domestics must be assisted in their passage over—they cannot come otherwise. The National Immigration law allows this. Why not let it apply to all farm labor? If Congress would only amend the law in this case it would greatly facilitate the immigration of farm labor. In Virginia these energetic and economical farm laborers would save enough from their wages in five years to buy a small tract of land and soon own their own homes. Tens of thousands of farm tenants, who are paying from $5.00 to $50.00 an acre a year money rent, would come to Virginia if they knew the opportunities that exist here. The small appropriation made by the Legislature is only sufficient to start this great work for Virginia. This work is the first that Virginia has ever begun in foreign countries. For twenty years the Western railroads and Canadian agents have been warning the home-seekers abroad "not to go South;" that the country was very unhealthy and very hot; overrun with negroes; that the new comer would have to eat and associate with the negroes; that the people died rapidly with fever. No one had ever denied these tales about Virginia before this past summer. The first work to be done must be educational, to refute these base slanders on the fairest land in the world. It is important that the first immigrants be well located and kindly treated. They will soon become the best advertisers the State can have. The act by the Legislature confines our work to farm labor. Our agents abroad are instructed to send only people who are used to work, and who expect to work when they get to Virginia. They have been coming every fortnight in bunches of 8 to 12 people—mostly families—and are located with farmers who have applied for them in the different sections of the State. Many farmers have written to the Commissioner telling how pleased they are with their foreign labor. That they find them industrious, honest and willing to do anything. They soon learn our Virginia ways in doing things and they look to their employer's interest. How different this is as compared to the common negro labor that our farmers are worrying with all over the State. The majority of the labor are heads of families, and the farmers who have them employed are assisting them to bring their families. In some of these families there are boys and girls who are old enough to do work—the boys on the farm and the daughters help the farmer's wife. In one family six boys came. Many of the first who came are writing home to their friends, advising them to come to Virginia, where they can better their condition in life. This is very hopeful for the future, because there is no better advertisement for a State than a satisfied immigrant. If this work will be properly supported by the State the increased demand for land in a few years will double the price of every acre of land in Virginia. The work will be kept going until it is hoped a larger appropriation will be made to greatly increase the results. People have come from England, Scotland, Ireland, Norway, Sweden, Denmark and Canada. Virginia has been advertised in the papers in all these countries, and pamphlets printed in the various languages. Many of the English and Scotch will come here from Canada, on account of the rigorous climate. The expense of three months' advertising and work of agents in Denmark—when 300 families were almost ready to sail, a number having already booked their passage—was frustrated by the Danish Minister in Washington, reporting to his country that Virginia and the South was a very unhealthy country, overrun with negroes and not suitable to the Danes. This false statement has checked the work in that country. Overwhelming evidence has been given the Danish Minister—the testimonials of Danes who have lived in Virginia for ten years, and by personal visits of Scandinavians to him in Washington—all assuring him of the healthfulness of our State and the salubrity of her climate, the hospitality of her people, the kindness of her soil, and the fine opportunities offered the industrious immigrant. But orders from the home government were no doubt to "send a warning to keep her people at home." Some Danish families have come anyhow, and more will follow. The Scandinavians make good laborers and farmers. They are trained to efficient and hard work; they are frugal, and would in a few years become owners of small

A Country Scene in Ireland.

farms. The Immigration Law permits the States to assist immigrants, and if sufficient funds were available the State could bring thousands to our farmers. The co-operation of farmers with the Department of Agriculture can be made helpful now. The majority of the immigrants are now coming from Great Britian. They are good, sturdy workers.

ENGLAND STOCK SHOW.

England is becoming more and more a stock and trucking country. The writer attended the Royal Stock Show (Fair) at Derby the past summer. This is the Great National Stock Show of England. The attendance was fifty thousand or more.

The King attended this show and exhibits stock also. They do there, as in America—put up prices at hotels, cabs, etc., on such occasions. There were over five hundred horses there of various breeds—from the fleet-footed hunters to the massive shires, that hoof the earth with a jar as they move about. The grooms, if you give them a chance, will give you a mile of pedigree of their stock. The horses are groomed with as much care as a lady makes her toilet. Every hair, even in the fetlock, must be in the right place, and their backs shine like a gentleman's silk hat. The classes of horses included hunters, hackneys, coach, ponies, mountain and Mooreland, Shetland and Poloshires, Clydesdale, Suffolk and Cleveland bays. The cattle exhibit was immense, there being more than 1,000 short horns there—about one-third of the entire cattle exhibit. The cattle—in fact, all the stock at the show—were groomed about as well as the horses. They were fat, sleek and shiny. Some with backs broad enough for a billiard table. The Jerseys were popular. The daintily-dressed ladies, who dragged their husbands quickly past the beef breeds, would hold up at the Jerseys. One exclaimed in the hearing of the writer: "Oh, you are a darling," as she saw a Jersey cow licking her fawn-colored calf. The beef breeds were largely in the majority. There were many strains of Short Horns, Herefords, Devons, Sussex Welsh, Red Polled, Arberdeen Angus, Galloways, Ayshires, Highland, Jerseys, Guernseys, Alderneys, Longhorns, Kerries and Dexters. Among the sheep were Shorphire, South Down, Hampshire Down, Suffolk, Lincoln, Leicester, Cotswolds, Romney Marsh, Wensleydales, Dorset, Devon Long Wool, Dartmoor, Exmoor, Cheviots, Black-Faced Mountain, Lonks, Herdwicks, Welsh, Mountain, Ryeland. Some of these breeds were new to the writer, but all of them were good for the section from which they came. In England much attention is given to the selection of the breed to suit local environment. There were the large, the middle, and the small white breeds of hogs. The large and small black breeds, the Berkshire, Tamworth, Essex, etc.

The English, Scotch and Irish are all lovers of good stock. Their green vales and moors and grassy slopes are dotted with sheep and cattle, that seem to be always fat. No wonder that their people feast on roast beef and mutton chops—famous the world over.

The country and homes in England are neat, clean and everything is in order. The lands are fertile and largely in grass. The green stretches and heathery hills of Scotland and her bold cliffs, that stop the surging seas, are ever fresh and entrancing. No one ever tires at looking at them. The people are sturdy, hale, even-paced, courteous—a great country and people. Ireland lies near by, with her ever-green mountains and swarded valleys, where cattle, sheep and horses are in every pasture. Old Ireland can boast of as fine thoroughbreds and hunters as the world ever produced. Dublin is a fine horse market for these classes of horses.

The high state of fertility and production in the European lands show the possibilities in farming—that lands can be farmed by correct rotation and manuring for 2,000 years and continue to grow larger crops. Our Virginia soil is naturally as good as that in Europe in many instances, and if farmed in like manner will produce just as well—

G. W. K.

FRUIT CULTURE.

A Well-Cared for Orchard is a Good Insurance Policy to Carry.

THE PRUNING OF FRUIT TREES.

The subject allotted me is one of the most important of all the subjects with which the Horticulturist has to deal. If in the construction of the large and beautiful edifices that are being built in every large city in our broad and beautiful country, you were to place their construction into unskilled hands, guided by an uneducated brain, although the stone, cement, wood and steel were of the best and a skilled architect were to make the most elaborate plans, writing out the minutest details for his guidance, yet failure would be inevitable; his work would lack strength, beauty, symmetry. So it is with the Horticulturist, he needs the same skill, the same training, with this difference. The Horticulturist must have a better education, a more cultured intellect and judgment above the ordinary. He has no plans for his guidance. He must be his own architect. You may argue that he has one of the greatest of all architects, one that gives him the most elaborate plans—Nature—the great architect of the universe. To some extent this is true. If you go into the virgin forest you frequently find the most beautiful trees, tall, erect, majestic in their strength, symmetrical in every outline, not a point left to be changed that would add to their attractiveness, but the Horticulturist who would benefit by following the teachings of this great architect must be a deep student of nature studies. She guards her secrets well, and only those who by close observation and deep thought delve beneath the surface are permitted to see and understand her intricate workings. Perhaps in the early days when Adam, the first Horticulturist, was placed in the Garden of Eden, it may not have required any particular skill on the part of Adam to give shape or in any way aid in the growth of the tree or the development of the most luscious fruit. An uneducated mind is satisfied with ordinary results. The child, if nothing better is in sight, is satisfied with little sour fruit growing in the hedgerow.

But we are living in a progressive age. The citizens of every town and city are becoming more cultured. Such products as supplied these cities in the early days of our forefathers no longer satisfy the citizens of to-day. They have tasted of better things. Their natures crave them and they demand them. We cannot adapt the people to our products. We must produce such goods as the educated tastes of the people demand; and of all the various products there are none that have a more rapid increase in demand than for high grade fancy fruit. This is no longer a luxury, but has become an actual necessity. It is becoming as staple as wheat or any other product. Thirty years back when I planted an apple orchard of fifteen acres my neighbors wanted to know what I was going to do with the fruit, claiming they had to leave their's rot, having no sale for it.

How is the outlook at the present time? Market prices for choice fruit are higher and the demand greater. Never in the history of our country were the prospects brighter than at present, for the future, for the intelligent and industrious horticulturist. In riding over the country it is a sad and painful sight to see the rapid decay of the orchards on large and otherwise thrifty farms which forty or fifty years ago had large, good bearing orchards, now have but remnants remaining; isolated trees scattered over large areas. These trees and parts of trees, long past their period of usefulness more through neglect and starvation than by old age, are left as feeding grounds for the tent caterpillar which defoliate them year after year, leaving their limbs exposed to the hot scorching sun, killing the bark, leaving them a prey to the flat-headed borer which soon destroys the little life that remains. These trees, once the admiration of the community, the delight of the children, the pride of the farmer, now stand bare and desolate with their epitaph written all over their scarred surface—died of neglect and starvation.

How to remedy this sad state of affairs and avoid its repetition in the future is what I am supposed to tell you. This is a difficult task, as it is a subject upon which opinions differ, nearly every horticulturist and fruit raiser having some pet theory of their own which have proven successful in their case. Why not? There is no one royal road to success; so that Nature's laws are carried out, it matters not if methods differ. One man plants and prunes according to his belief in the characters of the constellations believing the sign of the virgin to be one of fruitfulness, in the first quarter with moon pointing down. Another believes the sign of the scale to be the right one, but he wants the last

A Well-Cared for Peach Orchard in Tidewater Virginia.

quarter, with moon pointing up. You will find in every community farmers perfectly sane on all else who will not plant their fence-posts when the moon points up or plant their beans when the moon points down. But the days of ignorance and superstition are fast passing away and the bright rays of science are lighting the pathway and guiding the footsteps of the modern horticulturist.

Pruning is the prime factor in the building up of a profitable orchard. The tree is as susceptible of training as a child; in fact, more so, as you can train a tree as you wish. You can prune for wood growth, you can prune for the development of fruit spurs. You can make or mar a tree by pruning. The old saying, "there is a time for everything," is especially true with pruning, and that time is when the tree requires it. The trouble with pruning is, the work is frequently put off from time to time, and then too much is done at once, frequently to the injury of the tree.

There is no branch in orcharding that requires better judgment than that of pruning. It is necessary to understand the nature and the habits of the tree you desire to prune; to understand the individuality of the root system as well as the top. Trees differ greatly both in root and top formation. The peach, being a vigorous, rampant grower, requiring large amount of available food for its growth and maintenance and maturing of its heavy crops of fruit, has a large number of fibrous roots starting from the body and larger roots than has the apple and pear. He should know where these new roots start first in a newly planted tree, whether from the fibrous roots, from the sides of the larger roots, from the cut ends or as adventitious roots starting from the body below the collar of the tree. When he understands these he is ready for the first step in pruning. What methods shall we adopt? The string-fellow method, cutting off all the roots close to the stem or leaving mere stubs. or shall we cut off all roots to about three inches from the stem, or shall we leave all roots ten to twelve or more inches long.

To decide as to the best method. a series of experiments were conducted at Newark, Del., first on heavy well-drained clay loam, with heavy subsoil eight to ten inches beneath the surface. Another trial was made at Seaford, Del., in a well-drained sandy loam with a stiff subsoil two feet beneath the surface, with 54 trees each of 2-year apple, 2-year pear, 1-year peach and 1-year plum. Of these 18 each were stub-pruned, 18 were pruned to 3 inches and 18 were pruned to 8 to 10 inches. Results at Newark of the 8-inch roots, 82½ per cent. lived; 3-inch roots, 97 per cent. lived; stub roots 62½ per cent. lived.

At Seaford, Del., 8-inch roots, 94 per cent. lived; 3-inch roots, 100 per cent. lived, and stub 86 per cent. lived.

Of those at Newark, 8-inch roots gave 82 per cent. first-class trees, 3-inch roots gave 92½ per cent. first-class trees, stub roots gave 22 per cent. first-class trees.

At Seaford, 8-inch roots gave 86 per cent. first-class, 3-inch roots gave 96 per cent. first-class, stub roots gave 51 per cent. first class.

In summing up we find that 3-inch pruned roots gave best results. Eight-inch roots came second, while the stub or string-fellow method gave very poor results.

I am frequently asked by some one who is not particularly in love with work and to whom the string-fellow is very alluring, as by this method all that is necessary is to make a hole in the ground with a crowbar, stick in the close-trimmed tree and close the hole, with no dirt to handle, whether this method is not as good as planting in large holes. This question can best be answered as follows:

In a moist soil, in a moist climate, in a moist year, fair results may be obtained. In stiff soils, in dry soils, in a dry climate, in a dry season results are sure to be a failure.

When shall we begin pruning? The first few years training of a young tree determines largely the form and future usefulness of the tree. When a young tree starts from the seed, bud or scion in a nursery row it sends outside limbs along its stem and these aid in giving the natural taper to the stem from the ground up, giving it stiffness. If these are removed too early while the tree is young, this symmetry is destroyed, the sap is driven to the top, the top increases faster than the trunk, it becomes spindly, the trunk cannot support the heavy top and the results are deformed trees which, when they come into the hands of the orchardist, need staking to support them. The experienced nurseryman never makes this mistake. Trees coming from a first-class nursery never need staking; it is only those improperly grown. The short time a tree is in the nursery is insufficient to give the tree the proper form. The real training between the age of three and six years comes under the hands of the farmer or fruit raiser, and the success of that orchard depends upon the practical knowledge and skill which he possesses. If he has no knowledge of the habits of growth of the different trees and gives them improper pruning in early life, all the skill he may attain in future years can never fully overcome the evils of early mistakes.

Very few trees coming from a nursery suit every one planting an orchard. Some want their trees with high tops, others want low-headed

A Pear Orchard in Full Bloom in Southside Virginia.

trees, and both may be right, as great success has been attained under both systems. The man who wishes to keep his orchard under cultivation, when in bearing, must have his trees trained higher, while the man who cultivates a few years, then adopts the mulch system, wants lower-headed trees. How shall this difficulty be overcome? By buying one-year old trees. I am frequently asked what aged trees to buy. I invariably recommend one-year old trees. My reasons are, first, getting a good, strong one-year old four to six feet from the bud you get the very cream of the nursery. Anyone familiar with nursery stock knows that only a small percentage gets that size in one year. It must have strong individuality, a strong root system, full of vigor and stored-up vitality. Such stock makes the very best foundation upon which to build. This is not the only advantage with such stock. You have, when cut back, a top and root properly balanced. You can form the head high or low, as you desire. Your first step in pruning is the shortening of the roots, cutting off all mutilated roots. Hold the tree with the top farthest from you and the roots facing you. Then with a sharp knife cut off all the roots to three or five-inch stubs with the cut from below outward.

The reason for this is when the tree is set in the hole the plane of the cut surface will be flat on the ground. In a very short time granulations will be thrown out and rootlets will be thrown outward and downward, and in a few weeks the young tree will be securely anchored. After the trees are all planted, then prune the tops. The reason for deferring this until the tree is planted, you can start all your tops at a uniform height. If the trees are two years old with tops formed, then cut back from one-half to two-thirds of last season's growth and always, unless the tree is very spreading, cut above an outside bud. If the tree is a one-year old, cut to a uniform height of two to three feet from the ground. Every one familiar with a young tree knows it is full of dormant buds from the crown to the top; not in straight lines, but ascending spirally around the tree. In a short time after the tree is planted and pruned, if the weather be warm, these buds swell and send forth young, tender shoots, making the stem quite green. Now is the time to form the top. Seize the top of tree with one hand, count five buds from above down, then grasp the tree at this point with the other hand and with a downward sweep you rub off all the buds below. This leaves five buds to form the new top. These limbs receiving all the nourishment they can use make rapid growth, and must be carefully watched, as they may become top-heavy. If such is the case, pinch off above the outside bud. This checks the rapid upward growth and makes the limb more sturdy. By this method you will have no forks. The terminal bud grows as a leader, and the four lower buds form four limbs, all growing out in regular order and no one quite opposite another, with an outward, upward tendency to each limb, having at its base a ring or collar formed which strengthens it to such extent that, though in future, when ladened with fruit, it may bend to the ground, it cannot split from the trunk. Very little more pruning is necessary during the first season. Early in spring of second season cut back fully one-half or better, two-thirds of last season's growth, except leader, which should not be cut back quite so hard unless you desire a very low spreading top. This pruning again gives the limbs an outward upward curve, thus spreading and forming an open head, giving that beautiful symmetrical form combining beauty and strength. If through any mishap, carelessness or otherwise, one of these limbs should be broken, leaving one side with a large gap, this may be remedied by, instead of cutting above an outside bud, you cut above a side bud facing the gap. Then as the new growth curves toward each other the gap is soon closed. You may perhaps have a few crooked trees (some varieties are naturally crooked growers). This can be easily remedied with that wonderful implement, the horticulturist's standby, the pruning knife. I do not mean a large cumbersome hooked knife. I never owned one. I mean an ordinary strong, sharp, pocket knife. With such I can cut off a limb one inch or more in diameter with one smooth, clean cut. It is all in knowing how. Grasp the limb with one hand, spring it upward and follow with the knife, giving it a good strong pressure, and you will be surprised how easily it is done. Now, as to your crooked tree. With the knife, make two or three perpendicular incisions in the concave portion of the tree the full length of the crook. Nature in her efforts to heal the wound throws out granulations. This part grows faster, fills up the hollow space, acting as a brace, and in two or three years the tree will be straight.

Fourth year. Perhaps by this time your trees may be too spreading. If so, prune to an outside bud, thus throwing your new growth upward and inward. It is presumed that you have cut out all unnecessary growth, and where two limbs cross one must be removed. But good judgment must be used to remove the right one, or later you must remove the other one, and this may leave a large, open space, making an unsightly gap and exposing the large limbs to sun-scald. If at any time you must remove a large limb, better paint the cut surface. Trees, hard-pruned, throw out many water sprouts. These should be removed, as they are useless, and rob the tree of so much nourishment, and make too much shade; but spare the fruit spurs. Many farmers, and even professional pruners, tree butchers I call them, do not know the difference between useless wood and fruit spurs.

In 1880 I planted fifteen acres of orchard. Tended it well. It became a model for beauty, and came into early bearing as any well-regulated orchard will. One day a gentleman called to see my orchard. After going through it he remarked: "You have a fine orchard, but you have made one serious mistake. You have too much wood in your trees." I asked him to show me where. He pointed to the fruit spurs of which I was so justly proud, and said they were robbers, and should come out. I told him I wanted them there. He left, assuring me I would find my mistake to my sorrow. He said he was a fruit raiser and knew what he was talking about.

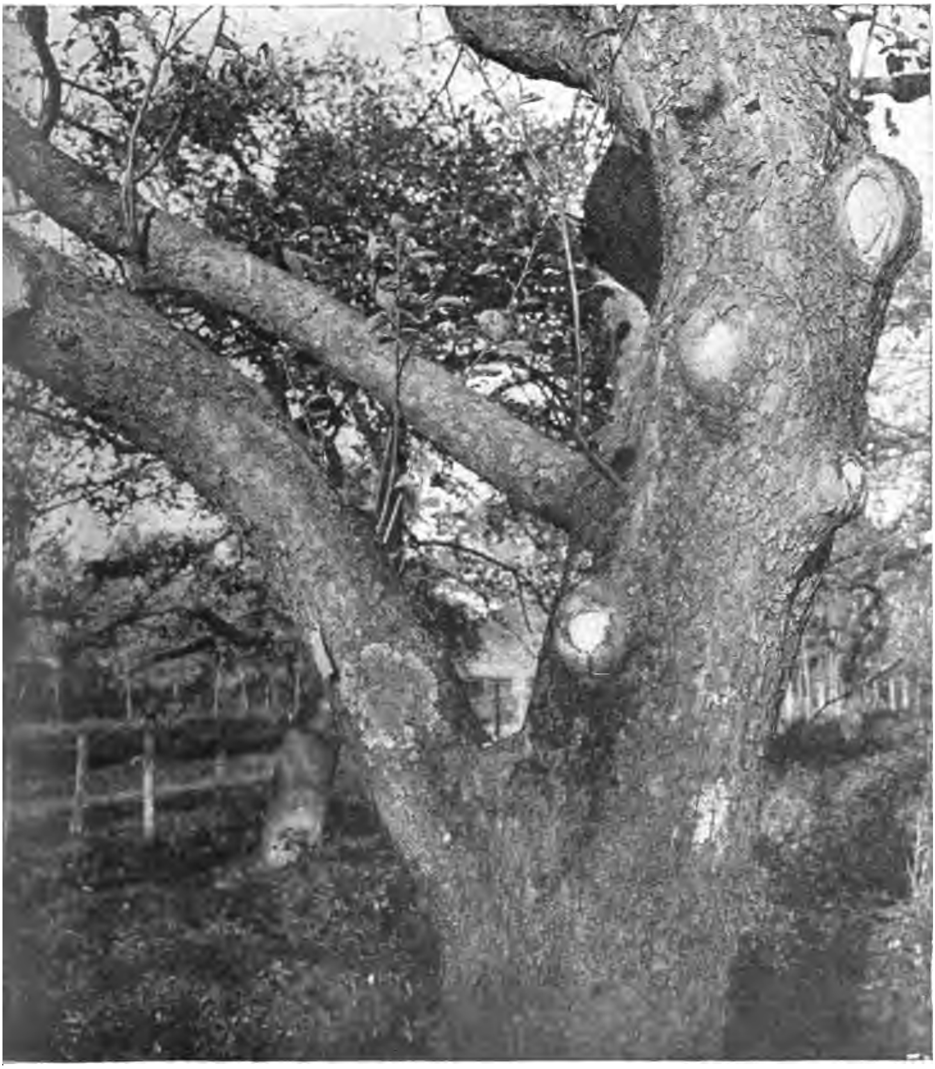
A few years later, when this orchard was heavily ladened with choice fruit well distributed through the entire tree, this same gentleman again called. After again going over the orchard he said he had an apology to make. I asked him what. He said when he was here before he had said there was too much wood in my trees. Now he saw I was right and he was wrong. My trees were bearing heavily and scarce bending the limbs, while he had cut out all the fruit spurs and driven all the fruit to the ends of the limbs, bending them down, exposing the bare limbs to the heat of the sun, killing the bark which was taken possession by the flat-headed borers and his orchard was ruined. In many sections there are people who make a specialty of grafting and pruning, traveling from farm to farm. Some of them may be all right, but most of them should be avoided as a mad dog. They tell you your orchard needs pruning, which is doubtless true, as I never saw one that did not. They tell you there is too much wood. You think, as it is their business they know it all, and as you are busy you turn them in. Later you come along to note progress and what a sight meets you. Your once beautiful trees now remind you of a post planted with a few poles stuck on the upper end with a brush tied on the upper end of each. This professional tree butcher has trimmed off every fruit spur that was along the main limbs, leaving them bare, not only destroying all hopes of early and heavy bearing, but inevitably destroying the health and longevity of the trees, as no tree can thrive with trunk and large limbs exposed to the hot sun. Farmer friends, if one of these men should call upon you, question him closely, and if you find him an imposter, turn the dogs on him. Many wish to know the best time to prune. That depends upon the object. In young trees where wood growth and tree formation are the principal objects, early spring or late fall is the best time. But if your orchards have an abundance of wood, having the age with no inclination to bear fruit, then you must adopt some other method. You must check the superfluous growth and direct its energies in other channels. There are various ways to attain this; perhaps you have been giving too much nitrogenous food and too high culture. Try seeding to grass for a season or two, giving it more potash and phosphoric acid, and prune your trees in June. You will find that instead of wasting its energies in making terminal wood it will develop fruit spurs throughout the tree, which the following season will bear an abundant crop. If a tree, after all judicious means has been tried, still fails to bear, try the heroic remedy, ringing the tree. Take a sharp knife, make an incision entirely around the trunk or limbs, make another one one-eighth or one-fourth inch from, but parallel with the first, and remove the strip of bark.. This must be done in June, when the sap flows freely, being careful not to destroy the cambium. Or you may wrap a wire tight around the limbs. Either of these methods check the return flow of sap and develops fruit buds. If you doubt, try it. It will respond without fail, and if properly done will do no injury to the tree. But, as my article is getting lengthy, I will close with a few safe rules.

Before planting, prune. After planting, prune. If growth is too strong, prune to check it. If the growth is too weak, prune to make more vigorous. Prune for wood, prune for fruit. Avoid all forks. Remove all cross limbs. Cut out all dead wood. On cutting off limbs leave no stubs, but cut close to the trunk or larger limbs. Keep the trunk and larger limbs shaded. Encourage growth of fruit spurs along all limbs, that the fruit will be well distributed and not all on outside limbs. By using good judgment, pruning and fertilizing liberally but judiciously the farmer will find the family orchard will be the most profitable part of his farm, besides the great pleasure it affords himself and family.—*Dr. J. H. Funk.*

MENDING OLD TREES.

THE SIMPLE ART OF PUTTING NEW VIGOR INTO OLD SPECIMENS THAT CANNOT BE REPLACED—MAKING REPAIRS AFTER INJURY FROM STORMS AND DISEASE, AND BRIDGE GRAFTING FOR NEW BARK.

The art of maintaining vigor in a tree that has attained its full development differs essentially from that which concerns itself with the



old apple tree has been given a new lease of life. The rotted knot holes were scraped out to live wood, painted, and filled with cement.

shaping of the young one. In young trees pruning is done with the special purpose of developing a well-formed head to the tree; but in after years the whole object of pruning is to maintain health and prevent as far as possible the attacks of disease, at the same time overcoming the results of injury and accident.

Most of the "accidents" that happen to old trees are the results of improper treatment or negligence during their youth.

REMOVING LARGE LIMBS.

Most fertile of all causes is the careless removal of limbs that have attained a diameter of a few inches. The best way to maintain health and vigor in the old tree is to see that when pruning is done on the young tree no stubs are left to rot and open up a channel for the entrance of fungous diseases or insects.

When removing a large branch, cut as close as possible to the trunk. The cut should begin from underneath, and after having sawn through about one-third of the way, begin with making a fresh cut on the upper side of the branch, and a few inches farther away from the trunk than where the first or lower cut was started. In dealing with a large or heavy branch, if this double cut is not made there is sure to be an ugly split when the branch is sawn nearly through from the top. It will fall by its own weight, and tear wood and bark from the trunk. The projecting stub must not be left thus. It should be again cut back so as to make an even plane with the trunk of the tree, and the surface smoothed off with a chisel, and immediately coated over with some antiseptic or preservative material. Any common paint is good; Bordeaux mixture may be used; but the best and often handiest preservative is coal tar. It repels insects, prevents the entrance of fungous diseases, is waterproof, and its dark color, hiding the white, newly cut surface of the wood, completely removes all appearance of the work that has been done.

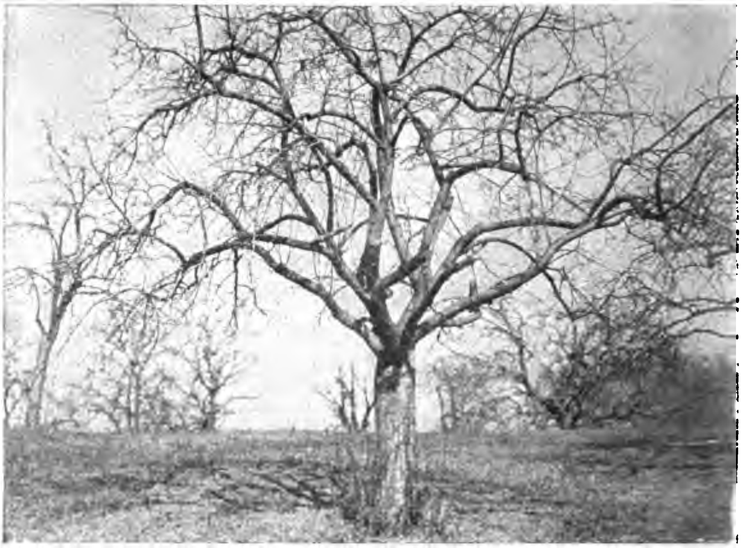
HOLES AND HOLLOW TRUNKS.

An unshortened stub, or one that has not been antiseptically treated, although properly shortened, will, unless the diameter of the cut is not more than two or three inches, inevitably rot, and form an ugly hole. Most trees that are split by the wind exhibit hollowness from some such source. If you have a tree with a cavity of this nature in its trunk, it can be saved for a great many years yet by thoroughly scraping out all the decaying surface matter, cutting away until live tissue is reached, then either painting or burning out the inside, and plugging up the hole by a piece of wood, or filling in with cement.

Old trees will very often have an A-shaped cavity at the base. The rot in this case works very slowly, as the disease does not travel upward so easily as it will work downward, and often indeed a tree will endure until its existence is ended, as a result of some other trouble. It is merely a question of time, however, when the heart wood will be entirely eaten up by the decay, and nothing but the shell of living bark stands to carry an over-heavy top. An unusually heavy windstorm finds such a tree an easy victim, especially if the branches are in full leafage. There is no need to despair, however, even though a tree be thus ancient and hollow. An entirely artificial heart can be put in. After having assured yourself that the interior has been thoroughly cleaned out, fill it up solid with cement, concrete, or even bricks and mortar. Build it up tight and well, and you will have a specimen that will defy the strongest storm that ever blew.

THE BROKEN CROTCH.

An evenly divided head—that is, where there are two leaders to a tree—is an ever-present source of danger. It will split. Sometimes, as a result of a hollow formed in the angle rot will start and gradually hollow out the trunk. Two things must then be done. First, the thorough cleansing and filling of the hole, and second, the bolting or bracing of the divergent limbs. Don't make the brace too near the crotch. It will be much more effective if it is several feet away from the crotch. The method of bracing is very important, and usually it is very badly done. The easiest way to brace the two limbs is to fasten a chain or cable around one, and extend it to the other, fastening it around that also. Mechanically, the desired result is attained. But something more than mechanics must be considered—the very habit of growth of the tree makes this method of bracing a sure forerunner of speedy death. As growth proceeds, and the limbs attain greater size, the inelastic chain or cable will cut into the bark and effectually "girdle" it. Inasmuch as the actual feeding of the tree takes place through the downward flow in the outer layers of the trunk (the bark), the effect of girdling or severing the bark in a complete circle is merely starvation to the lower part of the tree. Above the girdle the branch will appreciably increase in size, below it remains as it was. Fortunately, there is little likelihood of the girdle becoming absolute, as the bark will grow over and around the cause of the constriction in most cases. But sometimes it is effective, and the roots of the tree die in the course of a few years. These girdled limbs are easily broken by high winds or storms.



A common sight in neglected orchards. The old apple tree is capable of bearing big crops of fruit, but it needs mending first.

Remove the root suckers and all the water sprouts. Clean out all wood that cannot develop freely, and encourages short, strong growth.

HOW TO FASTEN.

Bolt the crotch. Do not support it by bands or chains. And there are right and wrong ways of bolting. The best way in fully grown trees is to bore a hole with an auger through both limbs, directly opposite each other, and pass through them an iron rod which fits snugly. This rod should be secured by a nut on each end, and sometimes a plate is used below the nut, to give greater security. If the nut alone is used on a still rapidly growing tree, the bark will gradually close over it, and the ends of the rod will be lost to sight. This makes a neat appearance, and is in every way satisfactory. On old trees, or on mature limbs, where any appreciable increase of girth cannot reasonably be expected, it will be better to countersink the head of the rod at each end, finishing off with a dressing of paint, filling the cavity with cement, and finishing off the surface to harmonize with the bark of the tree. One of the illustrations at the bottom of page .... shows the right and wrong methods of bolting. Another satisfactory method, where the decaying crotch has been filled in with cement, is shown at the top of the same page. This latter treatment can be applied when it is desired to retain a branch that has been broken down, but which is not entirely severed from the trunk. As a rule, however, a better result in years to come will be had from the immediate removal of the broken branch and encouragement of fresh growth. It will develop very rapidly.

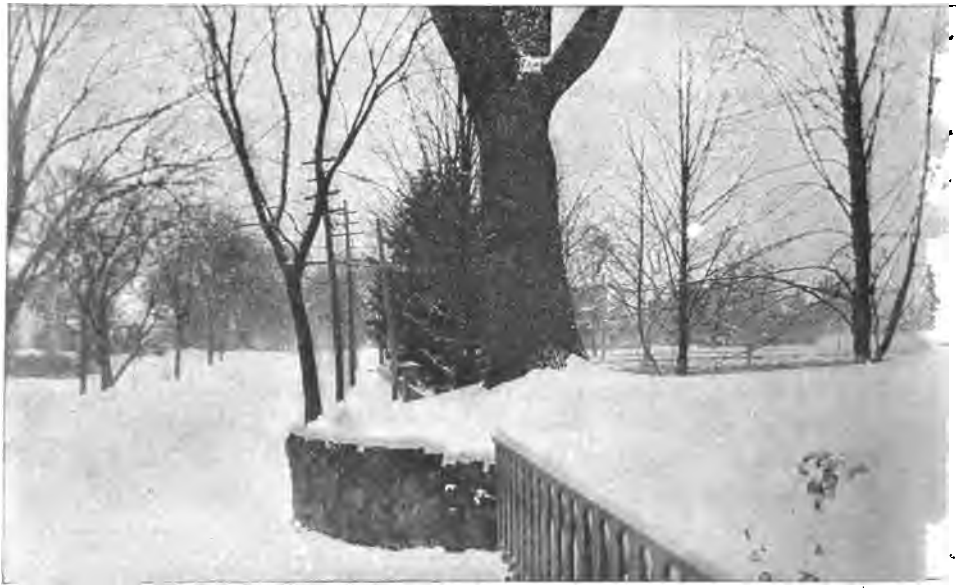
COLD SPLITS IN YOUNG TREES.

As a result of excessively cold weather, young fruit trees will often split perpendicularly along the trunk. The bark must be induced to grow again by cutting back into the clean growing tissue, and treating the surface of the wound that is exposed to the air just the same as is done for surfaces exposed by cutting or pruning. If this is attended to in the early spring, the wound should heal completely in a year, and the tree will live to a healthy old age, quite independently of this accident. If neglected, however, a wound of this nature is likely to become troublesome in so short a time that the owner of the tree will never need to concern himself with the art of mending old ones.

The treatment above described should also be given to any large trees that have been struck by lightning.

BRIDGE GRAFTING.

Professional horticulturists often resort to what is known as bridge grafting to secure a quick, new growth of bark over a large-sized wound. If a branch having a diameter of nearly a foot is removed, it will take several years before the new growth of the bark will completely cover it. The result can be hastened by taking cions and sharpening each end, as for cleft grafting, and inserting them under the bark, where they will make a union. Grafting wax should be applied at the point of union, in order to keep out water. These cions will quickly cover the exposed surface, making a perfect union. Repairs to old trees are best done any time during the winter because of the absence of foliage. Bridge grafting is best done in the spring time, when growth is most active, and the whole detail of chopping, cleaning, and repairing is perhaps more conveniently and better done in January than at any other time of the year. If it is not done in the very early spring, attend to it in November, before the advent of heavy frosts.—*Courtesy Doubleday, Page & Co. Copyrighted.*



Never uncover the roots of an old established tree when grading—the risk is too great, even if anchorage alone is considered. Build up a retaining wall, like this.

LIST OF BEST FRUITS FCR THE DIFFERENT SECTIONS OF VIRGINIA.

Frequent inquiries have been received as to the best varieties of fruits suited to certain sections of the State. The list here given is the one recommended by our State Horticulturial Society.

The subject of the adaptation of varieties of fruits to different soils of Virginia is next in importance to a study of the soils themselves. To actually make a critical study of this subject is beyond the power of any one man or dozen men; but personal observation, supplemented by a consensus of the best experience gathered from the State at large, ought to furnish very useful data. It is in this manner we have prepared the list submitted. In this list are included only such fruits as are thought to be the standard old varieties and a few of the most promising newer sorts. It is scarcely to be expected that this list will meet the entire approval of all our fruit growers, but it is thought to be a step in the right direction, and we earnestly invite all helpful criticism.

A Nice Way to Market Your Best Apples.

There can be no greater mistake made than to plant an ill-assorted lot of varieties of fruit. A few well selected kinds is the first essential to success in commercial fruit-culture.

EXPLANATION OF SIGNS AND LETTERS USED.

The star (*) is used to commend a variety; when it is desired to highly recommend a variety a double star (**) is used in the column under appropriate sections of the State, or in several, or in all sections, as may be thought proper. A single star commends a variety less highly, and a dagger (†) indicates that a variety is thought promising or should be tested.

Color is indicated by various letters. As A, for amber; B, for black; Bl, blue; Br, brown; C, crimson; D, dark; G, green; L, light; P, purple; R, red; Ru, russet; Sc, scarlet; Str, striped; W, white; Y, yellow. Combinations of these letters indicate shades of colors.

Quality is indicated on a scale of 0-10. The figures set in this column indicate our judgment on this point, 10 being the highest standard.

Season is indicated, first by separating the varieties into groups as near as was practicable, then in each group E is used for early; VE. very early; M, medium; L, late, and other combinations which will be readily understood.

Use is indicated by K for kitchen, meaning all culinary uses; M. market, and D, dessert. Under grapes, W, for wine.

Origin, when known, is indicated by abbreviations readily understood. In this column we have followed the American Pomological Society's lists when the varieties occur therein and in all other points have consulted that list, though differing from it materially on some points.

APPLES.

NAME.	Color.	Quality.	Season.	Use.	Tidewater.	Middle Virginia.	Piedmont.	Valley.	Appalachia.	Origin.	REMARKS.
Summer.											
Chenango	R. Str.	9	E.	K.M. D	**	**	*	*	*	N Y	Subject to blight.
Early Harvest	Y. W.	8	V. E.	K.M. D	*	**	*	*	*	Am	Not equal to next on list.
Early Ripe	Y.	9	E.	K.M. D	**	*	*	**	**	Pa	One of the best for culinary use.
Red Astrachan	R.	5-6	E.	K. M.	*	..	**	*	*	Rus	Ripens unevenly.
Summer Pearmain ..	R. Ru.	10	M. E.	K. D.	..	**	**	*	..	Am	
Yellow Tran'pt......	Y.	7	E.	K. M.	*	*	*	..	*	Rus	
Autumn.											
Bonum	R.	6	L.	M. D.	**	**	**	..	..	N C	
Buckingham	R. Str.	9	L.	K.M. D	*	*	**	**	**	Va	Excellent for culinary purposes.
Fall Pippin..........	Y.	10	M.	K. M.	..	..	*	*	**	Am	Excellent for culinary and dessert.
Grimes (*Golden*)....	Y.	10	L.	M. D.	*	*	..	..	..	Va	Mostly dessert apple. Late autumn in lower Virginia.
Via	R.	7	L.	K. D.	**	**	..	*	*	.....	Early winter in upper Virginia.
Maiden Blush.......	Y. R.	7	E.	K.M. D	*	*	*	**	**	N J	One of the best for family and market.
Mangum .... (*Fall Cheese*) ..	Y. R. Str.	7-8	M.	K.M. D	..	**	*	*	*	Am	An excellent apple.
Smokehouse	Y. R.	8-10	M. L.	K.M. D	..	..	*	*	*	Pa	Fine dessert and cooking apple.
Winter.											
Albemarle Pippin....	Y.	10	V. L.	K.M. D	..	..	**	*	†	N Y	Should be limited to special soils.
Arkansas .... (*Black Twig*)...	R.	10	L.	K. M.	**	**	**	**	**	Ark	Strong grower; good shipper.
Ben Davis..........	Y. R. Srt.	4	L.	M.	*	*	*	*	**	Ky?	Early bearer; ships well.
Gano	R. Str.	5	L.	M.		*	*	*	*	Ten	Better market variety than Ben Davis.
Grimes (*Golden*).....	Y.	10	E.	M. D.	..	..	**	**	**	Va	Mostly dessert apple. Early winter mountain districts.
Jonathan	R.	9	E.	K.M. D	*	..	..	*	*	N Y	Beautiful, quality fine, not well tested.
Winesap	R.	9	L.	K.M. D	**	**	**	*	*	N J	Best red variety where soil suits.
York Imperial...... (*J. F. Winter*)...	Y. R. Str.	7	L.	K.M. D	**	**	**	**	**	Pa	A standard shipping variety. Blights badly.

QUINCES.

NAME.	Color.	Quality.	Season.	Tidewater.	Middle Virginia.	Piedmont.	Valley.	Appalachia.	Origin.	REMARKS.
Champion	G. Y.	9	M.	**	*	*	*	**	Am.	Good variety.
Meech (*Prolific*)......	Y.	6	M.	..	*	*	*	..	N. J.	
Orange	Y.	10	E.	**	*	*	**	**	Am.	Good variety.
Rhea (*Mammoth*).....	Y.	7	E.	..	..	**	..	..	N. J.	

PEARS.

NAME.	Color.	Quality.	Season.	Use.	Stan'd or Dwarf.	Tidewater.	Middle Virginia.	Piedmont.	Valley.	Appalachin.	Origin.	REMARKS.
SUMMER.												
Bartlett	Ru.	8-9	L. S.	K.D.M	S.	**	**	**	**	**	Eng	Old standard.
Elizabeth (*Mannings*)...	Y. R.	6-7	S.	D.	D.	**	..	..	**	**	Belg	Abundant bearer.
Le Conte	Y.	3-4	M.	M.	S.	**	**	..	..	..	Am	
Summer Doyenne..	Y. Ru	4-5	E. S.	D.	S.	..	**	*	**	*	Belg	Best of very earliest.
Tyson	Y. Ru	8-9	S.	M. D.	S.	**	*	**	**	**	Pa	Finest quality.
AUTUMN.												
Angouleme (*Duchess*).....	Y.Ru	5-6	A.	M.	D-S	**	*	*	**	**	Fr	Good cropper.
Bosc	Y.Ru	10	A.	M.D.	S.	..	..	*	*	*	Belg	Poor grower—splendid quality
Kieffer	Y. C.	4 5	L. A.	K. M.	S.	**	**	**	**	**	Pa	Heavy bearer; quality medium.
Seckel	Br Ru	10	A.	K.M.D	D-S	**	**	**	**	**	Pa.	Good quality; family use.
Sheldon	Br Ru	7-8	A.	M. D.	S.	**	*	*	**	**	N Y	Good size and fair quality.
WINTER.												
Lawrence	R. Ru	7-8	W.	M. D.	D.S	**	*	*	**	**	N Y	Early winter; excellent quality.

CHERRIES.

NAME.	Color.	Quality.	Season.	Use.	Tidewater.	Middle Virginia.	Piedmont.	Valley.	Appalachia.	Origin.	REMARKS.
DUKE.											
Hortense (*Reine*)....	L R.	7-8	E.	K.M. D	..	..	..	**	**	Fr	Best sub-acid ch'y.
May Duke..........	R.	8-9	E.	K.M. D	**	*	*	**	**	Fr	Generally desirable.
HEART.											
Early Purple....... (*Giugne*)	P. R.	6-7	V. E	M.	..	*	**	**	**	?	Hardy, not extra fine.
Schmidt	R.	9-10	V. E.	K.M. D	..	..	*	**	**	Eur	A fine cherry.
Tartarian	B.	10	E.	K. D.	..	*	**	**	*	Ru s	Fine Quality.
Windsor	R.	8	L.	K. M.	..	..	..	**	**	Ont	Hardy, good bearer.
Wood (*Gov.*)	Y. R.	7	E.	K.M. D	..	*	**	**	..	O.	Rots very badly.
MORELLO.											
Montmorency Large.	R.	8	M.	K. M.	**	*	*	**	**	Fr.	Exc. late sour cherry.
Olivet	R.	7	E.	....	*	*	*	**	**	Fr.	The best early sour cherry.
Ostheim	R.	6	E.	....	..	..	..	**	**	.....	Small, very fruitful.

Early Richmond is quite inferior to the Morellos mentioned above.

PEACHES.

NAME.	Color.	Quality.	Adhesion.	Color of Flesh.	Season.	Use.	Tidewater.	Middle Virginia.	Piedmont..	Valley.	Appalachia.	Origin.	REMARKS.
VERY EARLY.													
Alexander	W. R.	5-6	S. C.	C W.	V. E	M. D	..	*	**	*	*	Ill.	
Greensboro	R Y.	6-7	Fr ?	W.	V.E.	M. D.	*	*	**	**	*	N.C.	
EARLY.													
Bishop (*Early*)		....	F.	W.	E.	M. D.	..	**	**	*	*	Tex.	Gd. commercial peach.
Carman	Y. R.	9	F.	W.	E.	M. D.	*	*	*	*	*		
Early Crawford	Y. R.	9-10	F.	Y.	E.	M. D.	**	*	**	**	**	N.J.	One of best in quality.
Lee (*General*) ..	G.	8	C.	E.	E.	M.	..	**	*	**	**	Am.	
Mountain Rose.	W. R.	7-8	F.	W.	E.	M. D.	**	*	**	**	*	N.J.	
St. John (*Yellow*)	Y. R	5-6	F.	Y.	E.	M. D.	..	..	**	**	..	Am.	
MEDIUM.													
Chairs Choice...	Y.	9	F.	Y.	M.	K. M.	*	*	*	**	*		
Chinese (*Cling*).	Y. C.	7-8	C.	R. W.	M.	K. M.	..	*	*	**	*	Am	
Elberta	Y. R.	7-8	F.	Y.	M.	K. M.	**	**	**	**	*	Ga.	Gd. commercial peach.
Late Crawford..	Y. R.	10	F.	Y.	M.	K.M.D	..	**	*	**	**	N. J.	Fine quality.
Oldmixon Cling.	C.	10	C.	W.	M.	K.M.	..	*	*	**	*	Am.	Stan'd sort.
Oldmixon Free..	C.	8-9	F.	W.	M.	K M.	**	*	**	*	**	Am	Stan'd sort.
Stump	Y. R.	5-6	F.	W.	M. to L.	K. M.	..	*	**	**	*	N.J.	Stan'd sort.
LATE.													
Bilyeu (*Comet*)	G. W.	7	F.	W.	L.	K. M.	..	..	**	**	*	Md.	One of best late market.
Heath (*Cling*)..	W. R	10	C.	W.	L.	K. M.	..	*	*	*	*	Md.	
Salway	Y. R.	5-6	F.	Y.	L.	M.	**	..	**	*	..	Eng.	
Smock	Y. R.	5 6	F.	Y.	L.	K. M.	..	**	*	*	*	N.J.	
VERY LATE.													
Albright (*Winter*	....	......	C.	W.	V. L.	K. M.	.	*	**	**	*		
Starke	....	.....	F.	Y.	V. L.	K.M.D	..	*	*	†	..	Va.	

PLUMS.

NAME.	Color.	Quality.	Adhesion.	Season.	Use.	Tidewater.	Middle Virginia.	Piedmont.	Valley.	Appalachia.	Origin.	REMARKS.
*JAPANESE GROUP.												
Prunus triflora.												
Abundance	P. R.	6-7	C.	E.	M. D	**	**	**	**	**	Jap.	Good bearer but not hardy.
Burbank	P. Y.	4-5	C.	M. L.	M.	**	*	**	**	..	Jap.	Good bearer, more hardy than abundance.
Ogon	Y.	6-7	F.	E.	K.M.D.	..	*	**	**	**	Jap.	
Red June	R.	4-5	S. C.	V.E	M.	..	..	**	*	*	Jap.	
Wickson	C.	5-6	C.	M.	M.	**	..	**	..	..	Cal.	
†EUROPEAN GROUP												
Pru. domestica.												
Bavay *Gr. Gage*....	G. Y	10	C.	M.	K.M.D	..	*	*	*	*	Belg.	Splendid plum.
Bradshaw	P.	4-6	F.	E.	K.M	..	...	*	**	*	Am.	Good canning.
Genil	Bl.	4-6	C.	E.	K. M.	..	..	*	*	*	N. Y	Good canning.
Lombard	P. R.	4-5	C.	M.	K. M.	..	..	*	*	*	N. Y.	Great bearer; rots badly.
Shrop's *Damson*....	Bl.	4-5	C.	L.	K. M.	..	..	*	**	**	Eng.	Best damson.
Yellow Egg........	Y.	10	C.	M.	K.M.D	*	*	*	*	**	Eur.	Splendid plums.
NATIVE GROUP.												
(*Prunus sp.*)												
Wild Goose........	P. R	4-5	C.	E.	K.M.D	**	**	**	*	*	T	

*Japanese plums do not rot quite so badly as the best European plums here.

†Most European plums rot badly here.

Very few persons have grown our native plums to such an extent in Virginia as to warrant recommendations.

GRAPES.

NAME.	Quality.	Season.	Use.	Tidewater.	Middle Virginia.	Piedmont.	Valley.	Appalachia.	Origin.	REMARKS
BLACK.										
Concord	8-9	M.	M. D.	**	**	*	**	**	Mass.	Old standard.
Campbell Early ...	7	L.	M. D.	...	†	†	*	*	Ohio	
Ives	5	M.	M.W.		*	*	*	*	Ohio	Stan. Com'cial grape.
Moore (*Early*).....	7	E.	M. D.	**	*	*	**	**	Mass	Standard early.
Norton	9	V. L.	W.	..	**	**	**	**	Va.	Stan. for claret wine.
RED.										
Brighton	10	M.	D.	*	**	**	**	**	N.Y	Excellent amateur.
Catawba	8	V.L.	M. W. D.	.	*	**	*	*	N. C.	Wine, late table grape.
Delaware	10	E.	M. W. D.	**	*	**	*	**	N. J. ?	Exc. where well grown.
WHITE.										
Diamond (*Moore's*).	7	M.	M. D.	..	..	**	**	†	N. Y.	Large, interesting amateur grape.
Martha	8-9	M. L.	M. D.	..	..	**	**	**	Mo.	Fine cul'y & table use..
Niagara	7	M.	M. D.	**	*	**	**	**	N. Y.	Excellent commercial.
Winchell	8	E.	D.	**	..	..	*	*	V..	Good quality.

RASPBERRIES.

NAME.	Color.	Quality.	Season.	Use.	Tidewater.	Middle Virginia.	Piedmont.	Valley.	Appalachia.	Origin.	REMARKS.
Conrath	B.	7	M.	M. D.	..	..	*	*	*	Mich.	Good size.
Gregg	B.	7	L.	K D.	..	..	**	**	**	Ind.	Standard late.
Cuthbert	R.	6	M.	M.D.	**	**	**	**	**	N. Y.	Standard red.
Miller	R.	7	V. E.	M.M.	**	*	..	*	..	Del.	
Golden (*Queen*)....	Y.	7	M.	D.	..	*	**	*	*	N. J.	The best yellow.
Pride (*of Ohio*) ...	B .	7	L.	M.D.	..	..	..	*	*	.....	The best late black

STRAWBERRIES.

NAME.	Color.	Quality.	Sex.	Use.	Season.	Tidewater.	Middle Virginia.	Piedmont.	Valley.	Appalachia.	Origin.	REMARKS.
Aroma	B.C.	8	Per.	M. D.	M.	**	**	..	..	..		
Bubach No. 5.....	S. C.	5	Imp.	M. D.	M.	**	**	*	**	**	Ill.	Old stand. sort.
Carrie	C.	7	Imp.	M. D.	M.	**	..	..	†	†	Va.	
Clyde	R.	8	Per.	M.	E.	..	**	*	*	*	Ka.	Very promising.
Gandy	C.	8	Per.	M. D.	L.	**	*	*	**	*	N. J.	Desirable late.
Haverland	S. C.	7	Imp.	M. D.	E.	..	*	**	*	*	N. J.	Heavy cropper; soft.
Michel (*Early*)....	R.	8	Per.	M. D.	V. E.	*	*	..	..	..	Ark.	Only for early.
Oreweiler	C.	8	Imp.	M. D.	L.	..	..	..	**	**	O.	Promising late.
Parker Earle	R.	8	Per.	M. D.	L.	..	..	**	*	*	Tex.	Only for amateur.
Sharpless	R.	10	Per.	M. D.	M.	*	*	**	*	*	Pa.	Good old variety.
Tennessee	C.	5	Per.	M. D.	E.	*	**	**	**	**	Ten.	Exc. commercial.
Thompson, *Lady*...	C.	7	Per.	M.	E.	*	**	**	*	..	N. C.	Bears too shy.

BLACKBERRIES.

Early Harvest.....	......	7	......	M. D.	V. E.	*	**	*	**	*	Ill.	Prob. best early.
Rathbun	......	8	......	M. D.	M.	..	..	*	**	*	N Y	A good new sort.
Taylor	......	10	......	M. D.	L.	..	..	*	**	**	Am.	The finest.

CURRANTS.

Champion	R.	5	.....	E. M.	K. M.	..	*	*	*	..	Eng.	
Cherry	R.	7	.....	M.	K. M.	..	*	*	**	**	Eur.	Standard red.
Fay	R.	6	.....	E.	K. M.	..	**	**	**	**	N. Y.	Exc. where succeeds.
Red Dutch	R.	8	.....	M.	K. M.	**	..	..	**	**	Eur.	Standard red.
White Grape......	W.	9	......	M.	K. M.	**	*	..	**	**	Eur.	Standard white.

GOOSEBERRIES.

Downing	G.	7	.....	M.	K. M.	**	**	**	**	**	N. Y.	Probably best for South.
Houghton	R. Y	8	....	M.	K. M.	**	*	*	**	**	Mass.	
Red Jacket	R.	8	....	E.	K. M.	..	**	**	**	**	Ont.	

APPLE-GROWERS WIN.

Early in the season New York apple-growers decided that their good fruit was worth $2 a barrel f. o. b., and decided to hold for that price. Buyers claimed that the large Western crop prevented this price being paid, and they decided to wait. A few of the buyers, however, realized that the Western crop had been over-estimated, and paid about $1.75 a barrel for their apples, for the growers came down to this basis, but not a cent lower.

As the season wore on, however, the buyers became uneasy; the Western crop was not turning out as large as had been expected; prices were not as low as had been predicted, and when freight charges were added the apples would be rather expensive when delivered in the East. The growers remained firm, and prepared to care for their own fruit. As the season closed, the buyers began to hustle for apples, and then the price had been advanced, and fruit moved readily at about $2.25 per barrel. Buyers who had declined to buy earlier in the season at $1.75 a barrel were compelled to pay 50 cents a barrel more for their apples—and they hastened to do this before the price again advanced. The growers, by holding their prices firm, had secured fair prices for their fruit.

It has been pretty well demonstrated by the experience of the past season that the grower who produces good fruit, and who is prepared to pack his apples, can get about what the crop is worth. It is the hap-hazard plan of waiting for the buyers to purchase the fruit on the trees which has worked the hardship this season. The experience of New York growers this season is worthy of careful study by all *Fruit-Grower* readers everywhere.

MR. LESTER'S HAY CROP.

Editor of the Henry Bulletin, Martinsville, Va.:

I thought perhaps you would like to have a statement of my hay crop for this year. I made and stored in my barns 3851 four-horse wagon loads of hay estimated to average 1500 pounds to the load making 2888¼ tons of average value of $18 per ton amounting to $51,988.50. No commercial fertilizer was used on the land where this hay was made, but I feed from 600 to 1000 head of horses, mules and cattle every winter and haul out from my barns and stables every spring from 1000 to 1200 tons of stable and barn yard manure which I scatter broadcast with manure spreaders and manure forks over my meadows. About one half of the land where this hay grew is bottom land and the other half is up land, supposed to be about 1200 acres all together. I would have made over 3000 tons of hay but for the early frost which cut my hay crop short from 100 to 200 tons.

My hay is mixed hay, consisting of orchard grass, red clover, herds, grass or red top, timothy, English blue grass, and Johnson grass, which makes a splendid feed for horses, cattle and mules. I feed my cattle no grain or ship stuff of any kind and some of them are fat enough in the spring for beef.—*H. C. Lester.*

INSECT PREVENTION.

In avoiding the ravages of insects it is as true, as in preventing other losses, that "an ounce of prevention is worth a pound of cure." It is possible by practicing certain methods to prevent the occurrence of many kinds of insects, some of which may never be remedied after they once appear. An example of this is the Hessian fly. There is no known remedy for this after once present in the wheat, although it is possible by two or three methods to prevent the occurrence of this insect.

The difference between remedy and prevention, therefore, is this: A remedy is a means that is applied to become rid of a pest or trouble after it is present, while a prevention is to be regarded more as a means of insuring against the possibility of its occurrence. It is easier to prevent the appearance of many insect pests than to remedy them, and it is also more certain and satisfactory. No one means of prevention will ever be found effective, but if the various methods that we here outline be closely followed, it is evident that combinations will result satisfactorily.

For system in treating the subject, it is here divided into four sections. In the first we deal with *farm practice,* which means good farming by various modified methods. One should be able to produce good crops, and at the same time avoid pests. This is the most important method of preventing insects, but it is so complex that it in turn must be treated in several sub-heads.

(1) Rotation of crops. Every farmer knows that this means avoiding the continued growth of one kind of crop upon the same land. We have invariably found pests to be most abundant in those fields where the same crop had been tried more or less continuously for years. The worst infested timothy field I ever saw was one that had been kept constantly in this kind of grass for sixteen years. Clover

fields generally die out in a comparatively short time, since the various kinds of pests that attack them become so abundant as to effect their destruction. The rotation of crops is especially desirable for such insects as root lice, and flea beetles, and others that do not travel any great distance. The flea beetle, which is often so injurious to both the leaves and tubers of potatoes in its adult and larval stages, respectively, is an example of an insect that should be prevented by rotation of crops, rather than remedied by any means that may be suggested. The necessity of rotation of crops is also to be emphasized in considering other insects, such as wireworms and cutworms, that live in the soil. This kind of rotation is important, for example, where corn is to follow sod. One should anticipate the attacks by cutworms and wireworms, and thus prevent their occurrence. In knowing that such attacks are likely to occur he may prevent them by certain farming methods, which we shall give presently.

Parallel with rotation of crops, we should call attention to the necessity of planting crops upon some portion of the farm not immediately adjacent to a field in which the same kind grew during the previous year. Many insects, such as the Hessian fly, are able to travel the short distance, but do not readily travel a great distance unless unusually favorable conditions occur. The practice of growing large areas of one kind of crop is also tending toward the increase of diseases and enemies of that kind of crop. For example, where peas have been grown in great quantities, there both pea lice and other pests of this particular plant have multiplied and proven especially destructive as a result. Where asparagus has been grown upon an extensive scale, the asparagus beetle and rust have been found most disastrous, and where much celery is cultivated there are to be seen celery caterpillars or striped worms, also rust, blight, etc. This applies to the enemies of most other crops, especially tobacco, potatoes, tomatoes, etc. Thus by rotation of the kind of crop, and by planting in a region where pests of that particular kind of crop have not occurred abundantly, such pests may be avoided.

(2) A careful selection of stock for growth is very important, whether this be seeds, plants or live stock. These should be examined to be sure that they are free from pests. For example, if peas and beans be infested with the weevil, or if wheat bought for seed be infested with granary pests, these insects are thus introduced into the premises, and are sure to be in readiness to attack the new crop in due season. Plants that are imported for growing, such as cabbage, toma-

toes, sweet potatoes, strawberries and others, should be examined to be sure that there are no lice or other pests upon the leaves, stems or roots, or within their tissues. Many fine strawberry beds have been ruined by introducing into them new plants which had strawberry lice upon the roots. It is far better to avoid this by examining the new plants and rejecting the entire lot among which even a few pests may be found.

The importance of a careful selection of fruit trees cannot be too greatly emphasized. The San Jose Scale has been introduced into nearly all the countries of our State solely upon nursery stock brought to orchards and planted there to bear fruit. Various other pests of fruit and ornamental trees are brought into our State upon infested trees, shrubs, and other plants, and it becomes almost impossible to eradicate them after they are once present. A rigid system of selection and inspection is the best means of preventing such pests. If a grower does not know his enemies, let him be on the safe side, and suspect every creature as being obnoxious until he can submit specimens to specialists and learn the truth.

The selection of resistant varieties of plants is also important, as the American varieties of grapes for avoiding Phylloxera, Uruguay potatoes to avoid blight and rot, Dawson's Golden Chaff wheat for avoiding Hessian Fly, Kieffer pear (though a poor variety) for San Jose Scale, etc.

(3) The dates of various farm operations are found to be important in preventing the occurrence of insects. This may at first seem strange; but let us cite examples: For cutworms or wireworms no remedies are entirely satisfactory; but is a preventive; one of the best measures is plowing and cultivating the soil in the late fall, as late as possible, and in early spring, as early as possible. These insects are in the larval stage in the ground, during winter, and if the soil be stirred at such time of the year that it will come in contact with them where they are too cold and stagnant or dormant to escape it, it will freeze against their bodies and kill them.

The date of seeding is also very important. As for example, in sowing wheat late to avoid the Hessian fly. In this State no wheat should be sown before the middle of September in the northern part and the first of October in the southern portion of the State. This is the best recommendation that can be given for preventing the injuries by this pest. However, it should be remembered that late seeding does not mean late plowing. The ground should be plowed early and put in the most perfect condition. A careful preparation of the seed-bed is always of great importance in giving vigor and growth to the plants, and consequently in making it possible for them to have strength to overcome the effects of their enemies. The date of setting out plants becomes important to avoid the enemies. It is possible, for example, to set cabbage in the spring at just such time that the cabbage root maggot or worm will attack it, because it will be the right date to receive the eggs of the fly from which this worm hatches. It is also possible, however, by planting cabbage a little earlier or just a little later to avoid the attacks of this pest, because the eggs of the flies will have been laid at the time of this planting. This is not only theory, but is the result of practice of persons giving us reports of such work.

The date of cultivation and the amount of cultivation become very important in preventing and destroying insects. For insects in the soil the more cultivation that can be given plants, the better, because pests are destroyed by that means, and plants are invigorated. The date of gathering a crop may vary according to the methods, the occasion, etc., and may be made such that serious pests will be destroyed or prevented. As for example, in destroying the clover seed midge, and preventing the occurrence of a second brood. This midge feeds in the larval stage in the young seed in the base of the blossom of red clover. One midge is at each single floret, but a hundred in a head. Where we see clover blossoms mature imperfectly, and only a few florets, or sometimes even none properly developed in a head, it means that this midge is present in destructive numbers. If clover be cut a week or two earlier than usual, the midge is killed by being brought to an untimely end, but when clover is permitted to remain until fairly ripened or almost ripened, as in accordance with the usual time for cutting clover, the midge falls to the ground and is ready to go into the pupal state there and emerge as a winged creature a short time later. It then lays its eggs in the heads of the second crop of clover, and thus destroys the seeds of the crop which we wish to mow and thresh for seed. It can be seen that early mowing of the first clover crop kills the midge in its worm stage, prevents its appearance to infest the second crop, and thus insures seed by a means better than any other that can be recommended.

(4) The immediate destruction of unused parts of plants and all fallen fruits is imperative if one wish to avoid their diseases and pests of plants of this kind during another year. For example, if one should cut off the tops of turnips and leave them in the field, the lice, and particularly the eggs of lice which infested these plants, would be left there to become the source of continued infestation next year. If cabbage

heads be cut out and some of the leaves and roots be left, the enemies which may be on, and in these parts left, will be continued. It is far better to pull stumps and all deformed, worthless and diseased plants, and throw them upon a hot brush fire before they wilt. If left until after they wilt, some of their insect enemies may escape from them, and remain to infest the next crop; likewise potato vines which may contain the borers which were so destructive in the various parts of this State during the past year. Pumpkin vines, squash vines, etc., which contain the destructive borers, leaves and other unused parts of plants should be destroyed just as soon as possible after the most valuable portion of the crop is gathered. This is not a remedy, but a means of prevention, as by this means the pest will not occur in such great numbers another year.

The necessity of the destruction of fallen fruits should be emphasized. In England the most successful orchardists are now keeping sheep and pigs in their orchards to destroy fallen fruits as rapidly as they drop. It is well known that such pests remain for a short time in such fruits. For example, the plum curculio, which stings not only plums, but peaches and apples, remains a short time, only a few days, in the fruits when they fall to the ground. If they be destroyed, the second brood of this pest is prevented. The same is true of the codling moth and various other insects, and is likewise just as true of various kinds of plant diseases. It should be here stated that these various means of preventing insects will, in almost all cases, be those that would be recommended by a botanist as a means of preventing destructive plant diseases.

(5) Clean farming. By this term we mean that kind of farm practice by which one gets rid of all rubbish about the premises, board piles, brush heaps, leaves, etc., in which various insects, such as the long brown stinking squash bug, asparagus beetles, etc., hibernate or spend the winter. It is a good plan to rake or scrape together all material from the truck-patch and field, and burn it in the fall, after the weather gets so cold that the insects are not likely to leave it, or in the spring before it gets so warm that these pests fly easily. However, care should be observed not to destroy the small snakes and toads that hibernate in such places. These are so beneficial that one will effect injury to his own interests if he does not watch and preserve them.

By clean farming, we also mean the destruction of all kinds of weeds and all plants that are out of place. Many insects feed on all plants belonging to certain respective botanical families, as, for example, the lice on the roots of the cabbage and cauliflower, feeding also upon mustard. The Harlequin cabbage bug feeds upon mustard as well as upon cabbage and cauliflower. The root lice of these plants also feed upon weeds as well as upon cultivated plants. Thus, it can be seen that if mustard, wild kale, etc., be permitted to grow about the premises, even though the insects be killed on the cultivated plants by cultivation and other means, they will be continued from year to year upon weeds. Some insects feed upon various kinds of weeds they do not have cultivated plants of certain kinds upon which to feed. An example is the Colorado potato beetle can live on the ground cherry. The destruction of weeds not only insures better crops, but also greater freedom from insect pests. The destruction or prevention of volunteer grain and plants that are out of place, also means the destruction of insects which they carry. If wheat be harvested after it becomes dead ripe, for example, and the grains be scattered freely in the field, there is not only loss from the wasted grain, but also growth of volunteer plants in which the Hessian fly and other wheat-destroying insects are almost sure to multiply.

If old or neglected trees be permitted to grow around the premises without care, they support the insects that will constantly menace and attack the desirable fruit trees. It is better to avoid this by destroying all plants and trees that are not needed.

This sub-heading of "clean farming" should include the destruction of dead trees and branches in the orchard, scraping trunks and larger limbs to remove the bark, moss and lichens on trees, and other operations which would prevent the insects from finding protection for pupation and hibernation. The codling moth, for example, passes the winter in the larval stage within silken cocoons beneath the scales of rough bark upon the trunks and larger branches of trees. Not only many insects, but those germs or spores that cause disease of plants, remain during the winter in the moss and lichens on the rough bark, and if each of these encumbrances be removed, the pests and diseases which they protect or harbor are likewise destroyed. The codling moth and other insects pupate during the summer time also beneath the bark of trees, and their places of pupation should be destroyed in order to prevent their finding safe retreats and expose them more readily to the attacks of their enemies. In dead wood there may often be found the disease germs and insects that caused the death of the wood, and if the branches be cut and burned at once, the causes of the trouble are destroyed, and future difficulties prevented.

In clean farming, one might also include clean soil, not only free from weeds, but also free from disease germs and insect pests. It is well known, for example, that potato scab, which causes the scabby appearance of potatoes, is a disease due to definite germs or organisms that live in the soil for years. When a field is once badly infested a potato grower should avoid planting upon this again until after he is assured there is no danger of infection.

(6) Killing pests while they are few in numbers is not only a temporary remedy, but is also a permanent means of preventing their occurrence in disastrous outbreaks. Many persons think that when insects are few they may be neglected without serious consequences. The evils of such negligence often become too plainly emphasized. For example, a grower of pickles came to see us a few years ago, saying that the large stinking squash bugs were destroying his entire crop of many acres for the third time that year. He said that they had been less abundant in previous years, but this was the first season in which they had occurred in such great numbers. He said that he had written to the United States Entomologist at Washington, and had been told that the chief cause of their prevalence during that particular year in that region was the failure of growers to attack and exterminate them while few in number during previous years. All insects are likely to increase until an outbreak occurs as a result of lack of check upon them. Prevent this by destroying all that are obnoxious, letting no guilty bug escape. At the same time one should know which are his friends and not exterminate them.

Many insects may be prevented by planting trap crops for them, as in planting a strip of wheat the last of August in order to receive the eggs of the Hessian fly, and destroying it later. This is a means of preventing the pests from laying their eggs in the regular crop, which is to be planted soon, and for which they might wait a short time. Another example of the trap crop to prevent insects from injuring the desired crop is beans scattered through the field where cucumbers, melons and squash are to be planted in order to attract the flea beetles and serve as preferred food for these pests while the desired plants may be so small as to be seriously injured by them. Yet another example of trap crop is mustard, permitted to grow in the vicinity of cabbage plants, cauliflower, radishes, etc., to catch the lice and root maggots, destroying it as soon as it is found to be infested

(7) A variation of the previous method is sowing a little lettuce among cucumber plants. This has been duly reported to us as beneficial

in driving away the enemies of the latter. Another plant likewise recommended for the same purpose is buckwheat, a few grains of which scattered among cucumber hills have been said to prevent the occurrence of the striped cucumber bugs. (An auditor here said that he had prevented the occurrence of these bugs in his cucumber fields by scattering walnut leaves among the plants.)

II. The second great group of preventatives is to be called *mechanical.* By this we mean any obstruction that will prevent the insect from getting to the plants. The efficiency of mechanical devices depends upon the completeness with which plants are protected, especially while they are young. It is well known that attacks upon young plants are much more serious than upon older ones. Among the mechanical appliances that have been used with satisfactory results one should mention wire netting put around fruit trees for borers. This should not touch the tree, as there is danger of eggs being laid through the meshes of the wire where it lies directly in contact with the bark. Paper closely wrapped around the tree serves the same purpose, and sticky substances, such as raupenleim and dendrolene, are also highly recommended as a means of protecting the trees from borers. A similar means of protection is a coating of paint made of pure white lead and linseed oil, of the consistency of cream or regular house paint, and applied to the trunks of the trees, down as far as possible, with a paint brush. Professor Alwood, of Virginia, has painted thousands of trees in this way, and reports that all have been protected in a proper manner and none have been injured.

Among the mechanical devices we should mention barriers to prevent climbing cutworms, canker-worms and other insects from ascending the trees. Bands of loose cotton tied around the trees will be found effective for this. Also sheets of paper, upon which tar has been spread, fastened firmly around the trees as sticky bands; also metal troughs filled with oil, even sheets of bright, smooth tin fastened around the trees will prove too slippery to prevent the crawling insects passing over them. Various devices have been patented recently and put upon the market for this purpose, but they are to be recommended for only a few insects, such as cankerworms and climbing cutworms.

If these are to be effective preventives, the time of year they are applied is to be considered. For canker-worms, trees should be banded at this time of year, or about the time the leaves commence to fall, since the females are wingless and climb the trees to deposit their eggs. They do this very late in the fall, or very early in the spring. There are two kinds of canker-worms, one called the fall canker-worm, because it climbs the trees and lays eggs in the fall, and the other the spring canker-worm because it leaves the ground to climb the trees and lay eggs in the early spring. Thus trees should be banded both in the fall and spring in regions where canker-worms or measuring worms have been recently known, in order to prevent the pests from occurring next year.

Another mechanical contrivance that is worthy of mention is a cloth basket for protecting cucumber plants. Make this by sticking the ends of two pliable twigs in the ground in such a way that the cross is at the middle of the arch like the central wickets in a croquet field. Over this double arch put a piece of closely woven mosquito netting or cheese-cloth, and spread earth around the edges to hold it down. The plant will need this protection only while young enough to keep within its limits. It is, perhaps, the best method to keep the plants protected from the striped cucumber bug. If the meshes of the mosquito netting be large enough to permit the entrance of the pest, it may sometimes crowd through, but we have known this to be prevented by dusting the plants with air-slaked lime to which a very little turpentine has been added.

One of the best means of preventing the attacks of the cabbage root maggot is to slit a number of pieces of paper from one side to the center, and put a pad or disk of paper around each plant just after it is set in the ground. When this pad is properly placed around the plant, flies cannot and will not lay their eggs at the roots.

III. *Chemical preventives*—The use of turpentine and lime and other substances might be called chemical rather than mechanical; but other methods are sometimes advisable, such as using a wash of potash, soap, acids, etc., in order to kill eggs or pupæ and prevent the next brood of insects, or prevent the laying of the eggs. It is especially desirable that in the fall or spring fruit trees should be washed with some such material. A wash of the bark of the trees with potash in water gives a very satisfactory result in preventing both diseases and insects during the coming year. Whitewash applied to the trunks of the trees, as well as to fences, destroys insects and specially prevents their attacks upon trees. A great deal of the value of the lime-sulphur-salt wash for the San Jose Scale lies not in its killing the adult scale, but in preventing the young insects from finding a fixing place. Lime or dilute Bordeaux mixture is used as a spray upon the leaves of potatoes for flea beetles, not because it is a remedy or kills them, but because it is a preventive or keeps them away. Lime is dusted around the roots of cabbage, onions and radishes, and prevents the flies which produce root maggots from laying their eggs in such places. Sand, with a little kerosene added, is a similar preventive of such pests. Not only for insects, but also for plant diseases, are such chemical preventives to be advocated. For example, a mixture of two parts of lime and one of salt, putting a small handful around each plant, or in the soil as it is set, is recommended as a preventive of club root of cabbage. We have had gratifying reports of formulas published in our *Monthly Bulletin* of the lime and sulphur as a preventive of club root. If we were discussing remedies, we should here mention nitrate of soda from one hundred to three hundred pounds per acre upon fields infested with Hessian fly. The purpose of this is to strengthen the wheat, and thus prevent death to the grain by the attacks of insects, rather than to remedy the trouble by killing the pests.

IV. Fourth and last in the group of preventives to be discussed is the general subject of *vital means*. By this we mean every method that will give life, vigor and vitality to the plant. Fertilizer in the soil, strong vigorous plants, good seed, good cultivation, pruning, thinning fruit, moisture, the absence of weeds and other means contribute as vital preventives of insects.

Under this head, however, we wish to emphasize the desirability of recognizing and preserving parasites. While parasitic insects are not of great importance during every year of their existence, they are the chief means by which nature suppresses insect outbreaks immediately following those years when such pests appear in immense numbers. When a diseased, sickly or parasitized insect is seen about the premises let it remain, with the assurance that it will soon die, and the cause of its destruction will multiply and pass to others of its kind. It is to be regretted that definite means for either the propagation or preservation of beneficial insects cannot be given.

Under the head of vital preventives we wish also to emphasize the necessity of knowing the higher enemies of insects, and preserving them at all times. Among these are toads, frogs and salamanders, serpents of all species, land turtles, etc. Also birds of nearly all kinds that may be found around the orchard or farm. These are natural enemies of insects, and feed while we sleep or work or rest. Let us learn to know them and preserve them in order that Nature's preventives may be effective and man's remedies may not be necessary.—*Professor Surface, Economic Zoologist.*

LIVE STOCK.

The Richest Agricultural Countries in the World are the Live Stock and Dairy Countries. There is no Reason Why Virginia Should Not be a Great Diary State.

THE EFFECTS OF FEEDS ON THE QUALITY AND QUANTITY OF MILK.

All acknowledge that there is some relation between the feed and the milk. If onions are fed to a cow it is expected that the milk will have the odor and flavor of onions. The same is true of turnips, but in a less degree. If, however, the turnips or cabbage are fed in moderate quantities directly after milking, no bad result is noticed, because in this case the system has had time enough to eliminate the malodorous material.

There is another feed—silage—that is fully as strong in odor as onions, and to some persons even more unpleasant, and yet a cow can consume large quantities of even the rankest silage and produce milk without a trace of the silage odor.

This is denied by many dairymen, but nevertheless it is a fact when a man says that he is having trouble with his milk on account of the feeding of silage, he is charging himself with carelessness, for it is certain that the bad flavors entered the milk after it was drawn from the cow. The silage odor is very penetrating. It hangs to the hair of the cow and the garments of the milkers; it fills the air of the stable. When silage is fed just before milking and then the milking done without washing the hands, the milk is almost sure to be tainted. Milk left in the stable easily absorbs the silage odor.

These odors that enter milk after it is drawn from the cow can be largely removed by aeration. Merely lifting the milk in a dipper and allowing it to fall in a current of pure air will remove the bad odors, but on a large scale it is better to use some of the modern machines that aerate and cool at the same time. To test this matter with regard to silage I once divided a lot of fresh milk, putting part in the silo on top of the silage in an open pail, while the rest was submerged at once in ice water. The milk remained in the silo several hours until it was thoroughly saturated with the silage odor. The pail was then removed to the dairy room and fresh air blown through the milk until the air as it bubbled up smelled no longer of silage. This milk also was then put in the ice water. The next day samples of each lot were submitted to a large dairy class without their knowing which was which. The majority of the class decided that the silage milk was the better flavor and had the less odor.

Why should good milk result from bad smelling silage and poor milk from onions? If a very thin slice of onion, turnip or cabbage is examined under a high power magnifying glass, the tissue will be seen filled with minute drops of a sulphur oil that imparts the peculiar odor and flavor. The system of the cow tries to burn up and get rid of all that would injure the milk, but these sulphur oils are among the most difficult to eliminate from the system and unless fed in quite small quantities produce a bad effect on the milk. On the other hand, the odor and taste of silage are connected with the acids of fermentation, and are easily destroyed by the cow. When silage first came into use, some persons claimed that the large quantity of acid it contained must be injurious to the health of the cow. A person who says this displays his ignorance of the cow's process of digestion. The first great stomach or paunch—occupying nearly half the cow's body—is, in effect, a silo. The food is here carried through the first stage of digestion entirely by the production of acid. No matter whether the food is green or dry, grain or coarse fodder, it is all fermented and produces large quantities of acid. Dry corn fodder in the cow's paunch evolves much more acid than the same stalks would have produced put green into the poorest silo. The cow's system burns up and utilizes this acid with ease, for that is what nature intended.

The feed has an effect on the color of the milk and the resulting cream or butter. Green grass, clover and carrots are well known to give a yellow color to milk and butter. Of the grains, corn and oats probably tend to produce a milk most satisfactory for general household use. On the other hand, buckwheat middlings has the most injurious effect. When the first two are fed with good clover hay, the cream is well colored and has a good consistency. It comes off the top of the pan in a thick layer and leaves skim milk that is noticeably different in color from the cream. If now the change is made to buckwheat middlings and timothy hay, the cream will become thinner and whiter. It will not cohere so that it can be removed as a layer, but will need to be dipped out a small amount at a time, and one can scarcely tell the cream from the skim milk. Such milk is unsatisfactory to the housewife, and it will be impossible to make her believe—what is, however, the fact—that the latter milk contains just as much cream and will make as much butter as the first.

The feed effects the hardness of the butter, that is, its ability to stand up in hot weather, and also its grain. Corn and oats make a good grained butter, wheat bran and linseed meal a poor grained, while if buckwheat middlings are fed in large quantities, a butter is produced that looks and cuts like lard. Gluten meal rich in fat makes a soft butter, while cotton-seed meal has the most pronounced effect of all the feeds in making the butter hard. Indeed in the South, where cottonseed is fed largely, the butter-fat is so hard that the churning temperature has to be raised at least five degrees.

The phrase of the question most interesting to the dairyman is, what should be fed to increase the amount of fat in the milk. So far no satisfactory affirmative answer has been given. The present belief of those who have studied the problem most thoroughly is that feed does not affect the richness of the milk, that is, the pounds of butter-fat in each hundred pounds of milk. The present doctrine is that each cow has her own normal richness of milk due to her individuality and her ancestry. This richness varies in different cows; in some it is three pounds of fat per hundred pounds of milk, others four pounds, some five pounds, and a few still higher. Any good, healthy food given in proper quantity will bring the cow up to this normal quality of milk, and after that no change of food can change quality, either to make it rich or poorer. During a long series of years I tried a great variety of feeding stuffs on cows to see if I could find one that would induce the cow to produce richer milk. Only once did I succeed. When "cream gluten meal" first came on the market, it was claimed by the makers to increase the per cent. of fat in the milk. I bought half a carload for experimental purposes, fed it to a herd of cows and noted the results with great care. The milk began at once to increase in quantity and improve in quality. When the experiment had lasted a week, I calculated that if it would do every time what it had done so far we could afford to pay eighty dollars a ton for it. Then one morning one of the best cows was found dead, and examination showed the others to be in a state of high fever. The dead cow's liver was found to be enormously enlarged. This explained the trouble. The liver is the part of the body that deals with fat in the food. The cream gluten meal was very rich in fat and the four pounds per day per head contained more fat than the liver could handle. An extra amount of fat had been thrown into the milk in the endeavor of the system to rid itself of the surplus. But it was at the expense of health, and the other cows would have soon succumbed had the feeding continued.

As already stated, this is the only time I have been able to trace any relation between the feed and the richness of the milk, though I have tried most of the feeds on the market in a great variety of combinations.

There are several changes in feed that are popularly supposed to influence the richness of the milk. Many believe that if a cow is fed heavily with salt so that she drinks an abnormally large amount of water, the result will be an increased flow of a poorer quality of milk. There is no such effect produced. Most dairymen believe that when the cows are fed any wet food in large quantity, as, for example, silage, roots or wet brewers' grains, a similar result will follow. Their belief is incorrect, and arose probably in large measure from the influence of such foods on the color and the consistency of the cream, as already mentioned. The belief is prevalent that when cows are turned to pasture in the spring, the change from dry feed to wet induces a larger flow of poorer milk. Indeed this idea is so grounded in dairy thought that it is incorporated in the laws of some States that allow a poorer quality of milk to be sold during May and June than during the rest of the year. I have tested this matter both with my own herd and with some three hundred cows belonging to several different farms and representing widely varying environment, feed and care. In some cases the milk improved slightly when the cows went to pasture, in some it changed in the opposite direction. The average was practically no change.

Yet every dairyman knows that milk varies in its richness. If, then, this is not due to the feed, what is the cause? Most of the variation is due to the changes in connection with the progress of the period of lactation. Just after a cow calves the milk is the thinnest it is to be anytime in the year, and it remains with but little change in quality until the cow gets in calf again. Then, as the quality of milk gradually decreases, the per cent. of fat slowly rises, and the milk is richest in fat just before the cow goes dry. The extent of the variation differs widely in different cows. In my own experience I have had a cow that gave at first milk containing three and a half per cent. of fat, and just before she went dry milk of four and a half per cent., increasing only one per cent. Another cow just doubled from three and a half to seven per cent., while still a third cow on calving gave seven per cent. milk, and the last milking before she went dry tested over fourteen per cent. of fat—it was cream rather than milk.

Then, too, there is usually a variation between the quality of the milk produced in the morning and in the evening. The rule is that the richer milk is given at the milking that occurs after the shorter number of hours between milkings. If the milking is done in the winter at seven in the morning and five in the evening, the evening's milk will be the richer, for there are only ten hours between the morning and evening milkings. In the summer when the hours of milking are reversed, the morning's milk will be the richer. After allowance has been made for all the above mentioned causes, there is still a daily and weekly fluctuation in the richness of the milk due to causes as yet unknown. But the fact of this variation is certain. I have found it in single cows and in large herds, when there was no assignable cause. I have isolated a fine, healthy, vigorous cow and treated her with exceptional care and regularity, and yet she has varied a whole per cent. in the richness of her milk during a single week. This phase of the subject needs to be made prominent because a lack of knowledge of the fact has led to many a wrangle and much hard feeling at creameries that pay by test. Because your test one week is different from the week before, do not jump at once to the conclusion that the creameryman has made a mistake or is trying to cheat you. Either may be true, but the variation in the test is not proof of either.

The statement has been made that no change of feed will make the milk richer. It is easy, however, to lessen the quality. Any irregularity in the daily routine will be reflected in a smaller quantity—a change in milkers or in the manner of milking, a change in the time, place or order of milking—anything that is not expected or a lack of anything that is expected by the cow will, to a greater or less extent, interfere with the perfect working of the cow as a machine. Fright has a powerful influence to take the fat out of milk. If the cow is driven to the barn by a barking cur, if she is beaten with the milk-stool for not standing still, a less quantity of a poorer quality of milk is sure to result. If she stands out in zero weather until chilled, or is compelled to occupy a cold stable, the owner is punished for his lack of kindness by a decided lack of milk and cream. In general, it can be said that anything that makes the cow uncomfortable in mind or body will both lessen the quantity of milk and decrease the per cent. of fat.

The quantity of milk can be varied between large extremes, and it can be said in general that a cow of the true dairy type gives more milk the more food she digests. The largest net profit is usually obtained by feeding a cow palatable, healthy and easily digested food, almost to the limit of her capacity.

If a richer milk is desired, it must be obtained by getting a different cow. In concise language, obtain quality of milk by breeding and quantity by feeding. But remember that only good, wholesome good given in clean, healthy surroundings will produce a quality of milk, cream or butter satisfactory to the patrons, and that the kindly treatment which keeps the cow comfortable in mind and body is the only method that will return full value for the food consumed.—*Professor Cooke, Washington, D. C.*

ECONOMY IN FEED ENGLISH METHODS.

The saving of feed is much promoted by allowing the animals to rest quietly without any excitement, and by keeping the stables at a temperature from 55 to 60. Degrees below this feed is consumed to keep up heat in the body, and above it perspiration is too free and causes loss by evaporation. A stall-fed beef will assimilate 17 per cent. of the feed given, and will consume daily from 11 to 13 pounds of feed per 100 pounds live weight.

A hog will consume 26 to 30 pounds dry feed weekly for every 100 pounds live weight. Hogs retain 20 per cent, sheep 12 per cent., and cattle 8 per cent. of the dry weight of the feed. Too much water in roots diminishes their feeding value, as a part of the heat produced is used in raising the temperature of the water to that of the body.

COW PEAS AND INTENSIVE CULTURE.

A man may have a very limited area under cultivation, but if he will keep part of that in cow peas, plant a still less acreage to cultivated crops, and with more intensive cultivation, and then keep alternating his tillage land with cow peas or clover and commercial crops, he will soon grow to be a very "big small farmer," or else a larger one; he simply cannot help himself. Cow peas will force him into prosperity.—*Rural News.*

RAISING MULES.

A LARGE ESTATE IN FAUQUIER DEVOTED TO RAISING THESE ANIMALS.—SPLENDID PRICES OBTAINED.

BEALETON, VA.—Strangers seeing the sights of Fauquier drift naturally to Warrenton, take a few short drives out into the surrounding country, admire the scenery, the well-kept farms and the magnificent horses; are charmed with the vivacity, culture and beauty of the gentler sex; listen to interesting stories of the many men who have made the old town famous in past days, and after a few glimpses out of the car windows leave under the impression they have seen everything that is worth seeing in the country. Yet, after due credit is given to all other sections, the rest of the county cannot furnish as interesting and striking a show as the mule farm of O. Shumate, about two miles north of this place. It also illustrates in a remarkable manner how one man with capital and enterprise can create an entirely new industry with a profit to himself and the greatest practical benefit to the agricultural class for many miles around.

A few years ago Mr. O. Shumate purchased the Shumate estate, then one of the most fertile and best kept farms in the country, since when he has increased his possessions by the purchase of adjoining estates, all of which have been improved by better fences—principally woven wire and oak plank—and the bringing of all the land up to an even, almost perfect, system of agriculture. His barns, for instance, are the largest and best arranged of any in this section, and all painted red with white trimmings, on a high elevation, catch the eye for many miles, while even his tenant houses are artistic and inviting to a degree that would make almost any city man fall in love with country life.

About three years ago Mr. Shumate decided to go to raising mules for the Southern cotton fields, and announced that he would like to buy about fifty good mule colts a year at weaning time and promising to pay good prices. Inferior or stunted colts he will have at no price; but for good colts his prices range from forty to sixty dollars, and even seventy for a four months' old colt. These high prices and the ready market opened up have resulted in a wonderful increase in the number of mule colts foaled in Fauquier county in the last couple of years. It encouraged Messrs. J. B. Jones & Co., of Morrisville, to import a thousand-dollar jack from Kentucky, and three jacks had stands within two miles of each other in the lower end of the county during the season just closed.

Other points in favor of raising mules are that a small mare may get just as large a mule colt as a big mare, and it is safe to breed a blind mare without fear of transmitting the weakness to the offspring.

As mules will thrive on coarser feed than a horse, are hardier, easier to break, and a pair three years old, well matched in weight, form and color, and broke to work, will bring from $400 to $800, it is easy to see there is a profit in it to the man who is properly prepared to take care of them.

The matching of young mules is always a very important point to a mule raiser, as mules are seldom sold singly. The above figures would naturally lead one to wonder why others did not enter into competition with Mr. Shumate. The large amount of capital required to engage in the business, and the long period during which this money must lie dormant, coupled with the high prices he pays and the possibility of mules taking a sudden fall in price about the time the first lot is ready for sale, easily deters others. And even though the possible profits are enormous, Mr. Shumate deserves the greatest appreciation for starting up a new industry in which the risks are so great, where the profits to others are so quick and large.

Stubble fields are carefully mowed and the hay stacked to furnish the young mules "a piece between meals" during the dead season of the year. Whole fields of rye are sowed to furnish winter grazing. An experiment is being tried with alfalfa. Eight acres were plowed up, covered over with well-rotted barn-yard manure, fifty bushels of lime applied to the acre, and after this was thoroughly incorporated with the soil and all was worked up to a fine tilth, the alfalfa was drilled in along with two hundred pounds of high-grade fertilizer to the acre.

A visit to this mule farm would painfully shock the rock-ribbed traditions held by the average man that kicking, jumping and general cussedness are born in each and every mule, and are utterly ineradicable. The writer saw Mr. Shumate go out in a large field and fifty-six yearling mules came half a mile in answer to his calls and crowded around him as affectionately as so many sheep, while he walked carelessly through them, stroking faces and patting shoulders or rumps in a way that would make the knees of the uninitiated tremble. A large drove of two-year-olds in another field proved just as gentle as did the forty or more colts purchased this year. Mr. Shumate declares it is all in the way you treat them, that there is no animal responds quicker to kind treatment than a mule, although he admits he owns one mule that will kick with its ears if its feet are tied.

Indeed, the stor yis told, whether fiction or truth the reader can be the judge, of an old, long-experienced sheep-killing dog, deceived by the gentleness of these creatures, thought that they were but a new breed of sheep, and with a longing to taste the flavor of the meat, he attacked them one night. It was his last sheep-killing expedition, as the natural courage of the animal speedily reasserted itself, and the dog was quickly kicked and stamped to death. Indeed, what has so often passed current as viciousness in a mule is probably nothing after all but intelligence, courage and a high spirit that resents abuse and mistreatment at the hands of a cruel, ignorant and unthinking master.—*Times-Dispatch.*

ERGOT AND ERGOTISM.

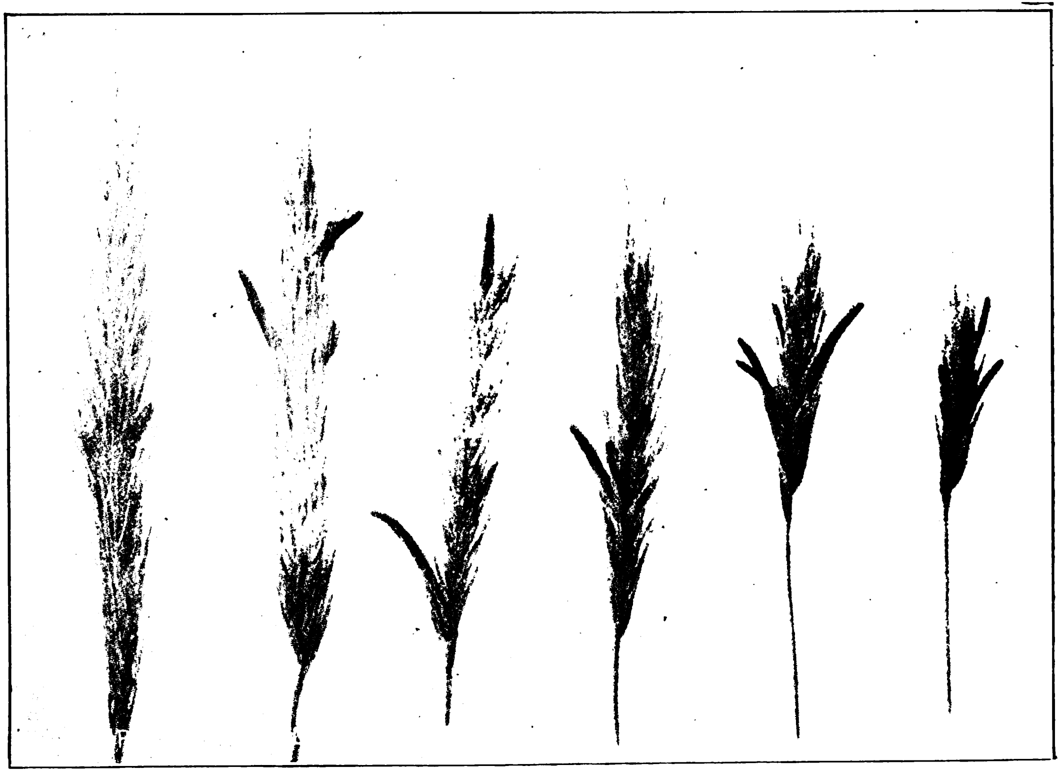
POISON TO LIVE STOCK.

The unusual amount of ergot upon several of the very common and important wild forage grasses of the State makes it highly important that a note of warning should be sent out to the stockmen, giving a short statement in regard to the nature of ergot and the injurious results which follow the feeding of hay that is badly affected.

NATURE OF ERGOT.

There is a parasitic fungus known as *Claviceps purpurea* that grows upon many different species of grasses and produces at one stage in its development black or purple enlarged spurs which take the place of the kernel or seed in the grass head. These spurs are called sclerotia or "ergots," and are simply aggregates of the vegetative body of the fungus, which remain dormant over winter and serve to reproduce the fungus the following spring. The original grass seed is entirely replaced by the fungus in the formation of these ergots, and poisonous principles are developed. When hay or grass containing any considerable quantity of these ergots is eaten by stock, the injurious effects described in the following pages may result.

The grasses which are most affected with ergot are the wild rye and wheat-grasses. Hay which consists largely of wheat and rye-grasses may contain as high as 5 or 6 per cent. of ergots by weight. Single heads of these grasses may produce from one to as high as forty ergots. Other grasses, such as timothy, blue-grass and brome-grass, are also at-



Ergot in wild rye grass, more abundant during wet seasons. It is poison to stock.

tacked by the ergot, but only occasional reports have been received of the presence of the fungus on these species. It is very common on rye in European countries, but in this country rye is less liable to attack.

PREVALENCE AND DISTRIBUTION.

During the past year the increased rainfall has been especially favorable for the development and spread of the ergot, and the amount has been gradually increasing.

LIFE-HISTORY OF THE ERGOT FUNGUS.

In order to understand the methods to be adopted in checking the spread of ergot, it is important to know the life-history of the organism. Several different stages in the life of the fungus may be noted, as follows:

1. *The sclerotium stage*—The dark horny spurs or "ergots" are characteristic of this stage. Unless the affected grasses are cut for hay these all finally fall to the ground and remain dormant over winter.
2. *The spore-fruit stage*—Shortly before the blossoming period of the grasses, these ergots produce several short erect stalks with globular heads. In these globular heads an immense number of slender thread-like reproductive bodies or spores are produced. These are carried to the blossoms of the grasses and infect the young ovaries.
3. *The sphacelia stage*—The young ovary is soon completely infested by the filaments of the fungus, and a second kind of spore is formed. At this stage a sweetish liquid is secreted which attracts insects. The insects carry the spores from flower to flower and thus cause the rapid spread of the disease if the climatic conditions are favorable. The fungus grows throughout the ovary and completely destroys it, and finally produces the sclerotium, or ergot, thus completing the life-history.

PREVENTION.

By pursuing proper methods much can be done to check the spread of the ergot, and also to make the infected grasses safer for feed. If grasses that are susceptible to the ergot are cut early in the season, or about flowering time, the ergots will not be formed. Hay which is cut at this stage is not poisonous to live stock, and the spread of the fungus to other wild or cultivated plants will be materially checked. Hay lands on which ergots have been matured may be burned over with some profit, as some of the sclerotia will be destroyed. If the ergot-producing grasses along roadsides and other waste places are cut several times each season, much good will also be accomplished. Finally, the seed of susceptible grasses should be examined for ergots, as the disease may be spread from infected seed.

SYMPTOMS.

The poisonous effect of ergot seems to appear in the late fall and winter, and we may find many cases during the winter and early spring, due to the *continuous feeding* of hay and straw that is heavily charged with the ergot fungus. Animals may lose parts of their tail or ears, or their hoofs may slough off. In others we may see only gangrenous sores. These may be seen on the teats or on the mouth. The most frequent lesions are those of loosening of the hoofs so that parts of the sole or wall may shed or slough off. We find this trouble more in cold than in warm weather, but this is not always the rule.

Cattle may also abort from eating forage that is heavily charged with ergot. Ergot acts on the nervous system and on the circulation. It is, however, not always true that large doses of ergot will produce abortion.

The symptoms are not very marked in the early stages. In advanced cases there is local gangrene of the mucous membrane. The extremities, such as the ears, tail, and lower part of the limbs, begin to gradually lose their warmth and sensibility, dry gangrene sets in, and the parts harden and become mummified, and finally drop off without pain.

TREATMENT.

As a preventive measure, the fields should be examined to see if they contain any ergots, as shown in figure 1. It is absolutely necessary to warn the farmers and stockmen against feeding this ergotized grain to their stock in winter, as it acts more rapidly and destructively in cold weather. Fields in which great quantities of ergot are found should not be cut for hay or pastured.

Medicinal treatment is not satisfactory in animals where the hoofs have sloughed off, on account of the time it would take to grow on a new hoof. This would incur a great deal of expense and sometimes more than the animal is worth. Where part of the tail or ears has dropped off, treatment can be used, such as cleaning the part with carbolic acid and then treating it as an ordinary wound, and discontinuing the feed that contains ergot, so that no more animals will become poisoned.—*Nebraska Bulletin No. 23.*

THE TRACTIVE FORCE OF HORSES

Showing the amount of extra force required on bad roads, over good roads. Force of traction required of one ton on a level road.

On rails, the force traction per ton, ...	8	pounds.
On pavement, ...	33	"
On macadamized road,...............	45	"
On hard dry turnpike, ...	68	"
On dirty, ...	88	"
On compact loam, ...	119	"
On gravel, ...	150	"
On sandy and gravelly, ...	210	"
On ordinary road, ...	237	"
On grass land, ...	300	"
On loose sandy road, ...	457	"

CONSUMPTION OF WATER BY STOCK.

It is important to give the stock plenty of water to maintain them in good condition. Approximately the following quantity is consumed per head each day:

Horses at pasture, ...	6	gallons.
Horses at work, ...	10	"
Bullock at pasture, ...	6	"
Cow in milk, ...	10	"
Sheep, ...	½	gallon.
Hog, ...	1½	"

In damp weather sheep require less water.

In England it is claimed that a cow in good health and properly fed will increase her yield of milk to her seventh year.

Ten quarts of milk should yield one quart of cream.

One quart of cream should make twelve onces of butter.

A CHEAP CONDIMENTAL FOOD.

Corn meal,	56	pounds.
Locust bean meal,	30	"
Linseed cake meal,	16	"
Sulphur,	2	"
Salt petre,	2	"
Salt,	2	"
Fenugreek,	1½	"
Gentian,	½	gallon.
Aniseed,	½	"
Ground ginger,	½	"
Carbonate soda,	½	"
Sulphate iron,	½	"
Leoigated antimony,	½	"
	112	pounds.

This, like other condimentals, are only good to sometimes stimulate the appetite in animals when it has been enfeebled by the use of unbalanced rations.

DRAFT OF HORSES.

A heavy draft horse should move at rate of two and a half miles per hour on a level hard road,	2 tons.
On inferior road,	1 ton.
On rails,	16 tons.

LIVE STOCK ARE MANURE FACTORIES.

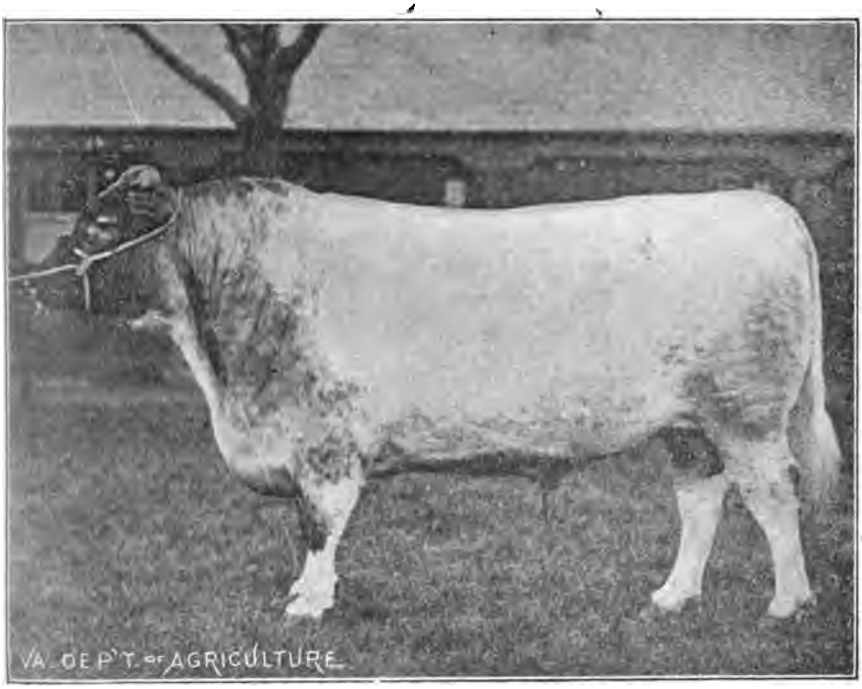
Fifty head of cattle in six months, well littered will make 500 tons of manure, worth, say, $2.00 per ton—$1,000.

The horse produces in a year: Solid manure, 12,000 pounds; liquid, 4,000.

Cow: Solid manure, 20,000 pounds; liquid, 8,000.

Sheep: Solid manure, 760 pounds; liquid, 380.

Hog: Solid manure, 1,800 pounds; liquid, 1,200.



A thoroughbred. No farmer can afford to breed from anything but a thoroughbred, in ANY KIND OF STOCK.

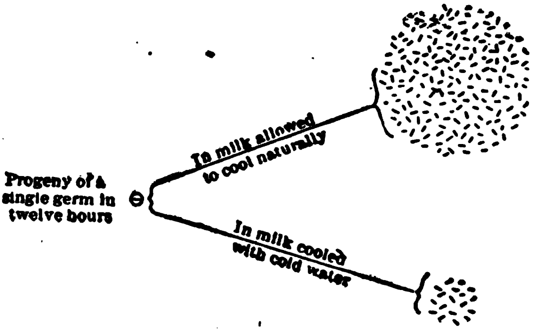
THE VALUE OF A COW.

The above heading is one which every cow keeper should always keep in mind in respect to each cow in his herd. A good cow is worth a good deal, while a poor one is worth nothing to keep. It costs but little more to feed and care for a good and profitable cow than it does to feed and care for a poor one. It costs in the neighborhood of $35 yearly to feed a cow. Supposing that the good cow produced 400 pounds of butter fat in a year, worth $88, the profit accruing from this would be $53. If the poor cow produced 170 pounds of fat, worth $37.40, she would yield a profit of only $2.40; the former yielding a profit twenty-two times as great as the latter one. This means that one good cow equals, in profits, twenty-two poor ones. The value of cows should be governed largely by what they can produce.

The above example is neither arbitrary nor abnormal. It is an actual case. Similar illustrations may be had on nearly all farms. Nearly all who keep cows at all have some good cows and some poor ones, some of them so poor as to run their owner in debt. It does not pay to keep these unprofitable cows, and, more than this, it does not pay to raise calves from such cows. The unprofitable ones should be sold and their calves had better be fattened and sold to the butcher, for it is seldom that they make good cows.

If a neighbor has a real good milk cow for sale, buy her, even though the price seems high.

When "Shep" goes after the cows he generally becomes ambitious, and rounds up the herd a little faster than is necessary.


Progeny of a single germ in twelve hours
In milk allowed to cool naturally
In milk cooled with cold water

Showing the effect of cooli milk on the growth of germs,

A herd of cows, galloping home from the pasture, their udders dangling from one side to the other, a cloud of dust surrounding them and followed by a barking dog or a boy on a pony, is something not conducive to good dairying.

If the milk is milked from clean cows into clean pails, by clean milkers, and cooled as much as possible, and as soon as possible, after it has been drawn from the cows, much worry, trouble and labor for the creamery and cheese-factory men are averted.

The making of good butter and cheese depends upon the kind of germs in the milk and cream, just the same as the quality of bread the housewife makes depends upon the kind of yeast used.

Undesirable germs are everywhere, and it is impossible under practical conditions to keep them out of the milk, so the next best thing is to cool the milk. Germs grow slowly at a low temperature.

HOW LAND MAY BE CHEAPLY IMPROVED BY GRAZING.

BY E. W. MAGRUDER.

Last summer I rode over a field which I had known for years and which had improved so much in the past ten years that I thought it worth while to give an account of the methods used to effect this improvement, especially as they are very cheap and easy to follow.

The field is sixty acres in size and lies on the eastern slope of the South West Mountains, in Central Virginia. The land was originally good, but for many years prior to 1896, when the present owner came into possession, it had been rented out to colored tenants, and so worked down, abused and worn out that there was only about ten acres in the bottoms that the colored tenants even would cultivate, and the whole field was turned out as a common. The field was largely covered with galls, sassafras bushes, and running briars; the grazing being suppplied by onions and chickory. A friend, after riding over the field, remarked that he did not see what good the field would be for grazing, as he had not seen a sprig of grass from one end to the other.

The purchaser in 1896 cut all bushes and cleared up the field as well as practical without plowing, and each spring for several years sowed Kentucky blue grass at the rate of a peck to the acre on the surface. Twice Japan clover has been sown on the tops of the hills, and one light application of acid phosphate was made.

The field has been grazed continuously, which has helped to keep down the filth, and for short periods, two or three winters, some hay and fodder have been fed to the stock on the gally places. The field has steadily and rapidly improved, the grazing being better each year than the year before, and the galls, briars and sassafras have as steadily disappeared, and now they are practically all gone.

The first year it took twelve days to bush it, while now half a day supplies.

The field is now practically all covered with a luxuriant growth of grass. From October to July blue glass furnishes excellent grazing, except, of course, during the winter weather, and during July, August and September Japan clover, crab grass and other summer grasses grow luxuriantly.

This field now *fattens very many more cattle* than it *barely kept alive* ten years ago.

The accompanying photograph, taken early last fall, shows the condition of the field now. I am sorry that no photograph was taken in 1894 with which to compare this one, but at that time this hill was mainly productive of galls and sassafras without a sprig of grass.

This field could have been gotten to its present productive condition much more quickly by cultivation accompanied with heavy applications of fertilizer or manure, but the cost would have been much greater, and at the time the owner did not have the money to expend on it, nor was he so situated that he could cultivate it.

The foregoing is given not as an illustration of the quickest or the best way to improve and build up worn-out land, but as the cheapest method to accomplish that end, and to show that by grazing and by judiciously helping the land a little the land will readily respond and show marked improvement. Therefore, if you have worn-out land, and have not the money to spend on improving it that you would like, or that some of your neighbors have, do not despair, but get some stocks, aid the land all you can, and the land will respond nobly.

ENGLISH WILTSHIRE BACON.

There is nothing in the breakfast bacon line that equals the Wiltshire English bacon. How they make it: For 200-lb. hogs, when the meat is cold and cut up, salt lightly and leave over night. Next morning brush off this salt; then rub in a layer of salt and one half pound of salt petre and 1 pound of brown sugar to each side of meat. Do this daily for three weeks, then wash it all off. Then smoke for a week; it is then ready for use.

DUSTLESS CLOVER.

U. S. Department of Agriculture is experimenting with a dustless variety of red clover brought from Russia. This clover is void of the numerous small hairs on the stems of our red clover, which causes dust in the hay and bloat in the green clover. No seed yet for distribution.

MISCELLANEOUS.

COMMERCIAL STOCK FEEDS.

BY B. W. MAGRUDER, J. B. ROBB AND H. L. DAVIDSON.

(From the Pure Food Bulletin.)

In Pure Food Bulletin No. 30 are given the results of the chemical analysis and microscopical examination of one hundred and ten samples of commercial stock feeds, consisting of wheat bran, chop, saccharine feed, cotton seed meal, middlings, corn feed, oat feed, mixed feeds, gluten feed, and several others, with two samples of condimental feeds.

In table below is given the average composition of these various materials when pure, as given in the publications of the U. S. Department of Agriculture. By means of these values, a comparison may be made between what was actually found in any feed here reported and the average composition of that feed. Of course, it could not be expected that every sample of feed would equal or go above the average composition of feed of that class, for the fact that there is an average, means that there are some samples which go below as well as some that go above that average.

In only two of the samples examined did the manufacturers guarantee the percentage of the valuable constituents. These are given in the table. This guarantee should be given in every case, as is done with fertilizers.

Hereafter the Board of Agriculture, according to its rulings, will require all commercial stock feeds to be sold under a guarantee, stating the minimum percentage of protein and fat they contain. This is an eminently proper requirement, as the purchaser should know what he is getting, and not have to buy blindly. Just as fertilizers have to be sold under a guarantee as to the percentages of phosphoric acid, ammonia and potash they contain, so stock feeds should be sold under a guarantee as to the percentages of *protein and fat* they contain, for is it not just as important to have *good food for stock* as for crops?

EXPLANATION OF THE TABLE.

In the table are given the percentages of water, ash, protein and fat, with the selling price per ton, and the constitutents, as shown by the microscopic examination.

Water—However dry a feed may appear, it always contains a considerable and variable quantity of water, which cannot be seen or felt, but which can be driven out by heat. This water is of no consequence unless present in an unduly large amount.

Ash—The ash is what is left after the combustible part of a feed has been burned away. When a large amount of ash is present, it shows that some mineral matter has been added as an adulterant.

Protein—The term protein is a general one, and is used to include all those nitrogenous materials which, when separated, bear a general resemblance in composition and properties to egg-albumin (white of egg, flesh-fibrin (lean meat), and milk-casein (curd). This portion of the food is essential to the formation in the animal of albumin, fibrin and casein; in other words, lean meat or muscle, bone, blood and milk. This is the most costly and by far the most valuable portion of stock feeds, and they should be bought for the protein which they contain.

Fat—All feeds contain more or less fat or oil, such as corn oil, cotton seed oil, etc., which is used by the animal to produce energy and heat, or is stored up in the animal body as fat.

If the percentage of water, ash, protein and fat are added up and subtracted from one hundred, the remainder will consist of fibre and nitrogen-free extract. The fibre is the essential constituent of the walls of vegetable cells, and is the most insoluble portion of the vegetable substance and of quite subordinate value in food. The nitrogen-free extract, sometimes called carbohydrates, includes starch, sugar, gum and pectin. The use of these substances in the animal body is similar to that of fat; they serve to furnish energy, heat and, after proper elaboration, fat. Fat, however, furnishes over twice as much heat and energy as the nitrogen-free extract.

Price per ton is the price asked by the merchant from whom the sample was drawn, and is given so that after comparison with the percentages of protein and fat it can be seen which is the cheapest feed.

Microscopical examination shows of what material or materials the feed is composed.

In studying the table it is seen that most of the samples are low in water, and that the amount of ash is about right, showing that no mineral has been added.

The bran was fairly good, none of it was adulterated, but some was low grade. Most of the feeds were of fairly good quality, some containing a few more hulls than they should, but the analyses on the whole show up quite well, except in some of the feeds which had a guarantee. Of the twenty-one samples which were furnished with a guarantee twelve fell below their guarantee in protein and three in fat. If all had been guaranteed, they might not have shown up as well as they do.

Two samples of condimental stock feeds are given, Nos. 496 and 497. (See Bulletin No. 30). No. 496 was nothing more than corn middlings with a little rye, and a very small amount of fenugreek, and salt, and sulphur, and No. 497 was wheat middlings, with a small amount of charcoal, fenugreek, salt and epsom salts. None of these added medicines were of any special value except under certain conditions, and generally they would be harmful rather than beneficial. The amount of them all in one ton of the feed is possibly worth fifty cents, but the feeds were sold at the rate of $166.00 and $125.00 per ton.

It is a perfect waste of money to buy these condimental stock feeds. If your stock need sulphur, epsom salts, fenugreek, etc., go to the drugstore and get five or ten cents' worth of each, and then you will know what you are doing, and besides you will not be giving $100.00 and $130.00 for what is worth not over fifty cents.

AVERAGE COMPOSITION OF PURE FEEDS NAMED.

NAME OF ARTICLE.	Water—Per Cent.	Ash—Per Cent.	Protein—Per Cent.	Fat—Per Cent.
Bran, Wheat	11.9	5.8	15.4	4.0
Middlings	12.1	3.3	15 6	4.0
Shorts	11.8	4.6	14.9	4.5
Corn	11.0	1.5	10.4	5.0
Corn Meal	15.0	1.4	9.2	3.8
Corn and Cob Meal	15.1	1.5	8.5	3.5
Oats	11.0	8.0	11.8	5 0
Cotton Seed Meal	8.2	7.2	42.3	13.1
Gluten Feed	7.8	1.1	24.0	10.6
Linseed Meal	10.1	5.8	33.2	8.0

The Pure Food Bulletins are sent free upon application.

SOME ESSENTIALS FOR THE FARMER POULTRY RAISER.

BY GEORGE SIXEAS.

The rapid growth of the poultry industry in this country during the past decade, and the steady demand, at high prices, for gilt-edge broilers and new-laid eggs has been remarkable. There is rapidly increasing in this country a class of consumers who demand the very best of everything without regard to prices. The opportunities for profit to those who can produce the better grade of poultry and eggs are almost limitless, and they will find that the buyer will seek the seller. It is estimated by those in the best position to know that the poultry products of this country are worth each year a round $500,000,000. The government figures that the poultry products are sixteen per cent. of the entire live stock industry. In 1899 Virginia produced $6,500,000 worth of poultry and eggs. In 1906 the value will be over $10,000,000. The average selling price of eggs in 1899 was 10½ cents per dozen. Our average paying price this year, direct to the producer, will be about 22 cents. In 1905 there was sold on New York City's wholesale market $81,000,000 in poultry and eggs. Yet at no time was the supply equal to the demand on the better grade of goods.

It is strange, but true, that the food cost is more to grow a pound of the cheap selling chicken than it is to grow a pound of the chicken that sells at the top of the market. It is our view that the farmer should grow two broods of chickens—one for meat, the other for eggs. The Plymouth Rock, when not in-bred, is the heartiest and best seller, and will grow quicker for less money a sweeter, more tender and juicier flesh than any other breed under the average attention. The Brown Leghorns will lay more eggs than any other breed, but it is our experience that the single-comb White Leghorn is the best breed for the large egg-farm. The way to handle the two breeds to keep them from mixing can be readily accomplished in gathering the eggs—the Brown Leghorns laying a white, and the Plymouth Rock a pinkish egg. Let your Plymouth Rock roosters run with hens all the time. During the months of April and May buy you a Leghorn rooster and put your best laying Leghorn hens in a pen. The eggs will be fertile in five days, and as soon as you have no further use for your Leghorn roosters kill or sell them at once. Never keep your laying hens more than a year after thev have commenced laying. Keep about a dozen old Plymouch Rock hens for early setters. The coops should be put in a dry place with the doors and windows on the opposite side from the prevailing winter winds. The house should be free from cracks and the roof from leaks. There should be at the side of the house a shed for them to stay under on snowy, windy or rainy days. The roost should be about four feet from the ground and on a level. Never let any chickens roost higher than others. The nests should be covered, so that the hens cannot roost in or over them. The coops to pen the little chicks in at night should be roomy with plank bottoms not attached to the coops, so you can lift them up and clean them often and easily. Clean the droppings under the roosts at least once each week and throw under them some dry earth. Once each month dust your hens with Pyrethrum powders, or melted lard mixed with coal oil, rubbing the feathers good after dipping your hands into the mixture. The best thing to keep down the lice is the use of fine, air-slacked lime. Throw several handfuls all around the coop, close the doors and windows, and, after the dust has settled, sweep it off the floors and roosts.

Twenty-four hours after taking the little chicks off the nest feed them for three or four days stale light bread soaked in milk. The next five days feed some kind of baked bread. Up until they are ten days old be sure to keep the hen tied or penned, so she will not run the little chicks to death. After the chicks are ten days old you can feed them cracked, broken grain or mashes; but never feed them corn meal mixed with water as a steady diet. Nor any kind of poultry at any time. It is the chief cause of so many chickens dying with diarrhœa. And remember always to compose your mashes of at least two different kinds of grain, and the more variety the better. The mash should be mixed with butter-milk when possible.

The best feed for broiling or frying chicks is cracked corn, beef scrap, and butter-milk, or mashes composed of bran and shorts, ground oats and corn meal mixed with butter-milk. The best feed for laying hens is cracked corn at night, with a mash composed of bran and shorts, oats and corn meal mixed with butter-milk for morning feed. If you have not the milk with which to mix the mash, use plenty of beef scrap.

Remember, to get eggs at the time of year they are selling high you must feed some kind of animal food to take the place of the bugs and worms that the hens pick up, and cannot find after the first frost. The best substitute is beef scrap and butter-milk. The question most frequently asked the writer is, "What must we do to make our hens lay?" After examining the fowls and premises, as a usual thing, we tell them to clean up the filthy old coops and lousy hens and put the hens on half rations for five days. Then clean up the coops again and the lice on the hens, and feed them all the corn they will eat at night and a mash in the morning composed of bran, corn meal and ground oats, mixed with butter-milk or bread scrap, with enough cayenne pepper added to make it hot. By way of change, if you have it, feed wheat, buckwheat, or a little rye. Always have plenty of gravel or grit hauled into the place where the chickens run.

We have seldom seen a chicken too sick for us to attempt to cure. When they have colds give them little quinine pills. When they have diarrhœa, give them a dose of castor oil. Feed them boiled rice mixed with scalded fresh milk. When they have the roop dip their heads into a tin can filled with a two per cent. solution of carbonic acid, or into a can of very warm soap suds till you think the chicken is about dead, then feed milk and bread, and plenty of cayenne pepper. For the gaps have you a small air-tight box with a glass in the top, into the box put a small iron kettle and into the kettle a few coals. On the coals put a few drops of carbolic acid and close the box. The chicken will soon get drunk and fall over. Then quickly throw the chicken into the fresh air. The gaps will be gone and the chicken will soon get sober.

Aim to market your eggs at least once each week. Never put them in salt, bran or pickle. Keep them in a cool place in pasteboard fillers that your buyer will furnish you. Just before selling clean the dirty spots from them with a dry cloth, and never wash them.

No poultry should be killed for market not in good condition. One of the most essential points in dressing poultry is to get all the blood out of the body. This is done by hanging the bird by the feet, taking hold of the wings and locking them (this can be done by bringing one over the other and catching the tip of the upper wing under that of the lower). Just the right thrust of the knife will reach the brain and paralyze the fowl. Relax all the muscles, so the feathers are easily removed and permit a free flow of blood before the fowl is dead. Do the sticking with a small keen knife. Make two long cuts along the chicken's throat and mouth, so as to sever the arteries, then quickly thrust the knife through the roof of the mouth into the brain, twist half around, quickly withdraw and commence to pull feathers. The proper killing is an art that requires practice and judgment. When the bird is picked, plunge into cold water and let it remain for an hour, then take out and hang up to cool. Pack as soon as the body is thoroughly dry and the animal heat has left the body. In dressing scalded stock have the water near the boiling point. Catch the bird by the head and feet, dip it into the water and twist it around for ten seconds, then quickly withdraw. (Do not dip the head into hot water, as it gives the fowl a sickly appearance.) Dip into cold water and hang up and pick. When picked catch by head and feet and plunge into boiling water for three seconds, then plunge into cold water and hang up to dry until ready to pack. The markets north of Baltimore call for dry-picked stock. In dry packing use clean, tight barrels or boxes. Line them with clean strong paper, putting a layer on top. Do not under any circumstances wrap the birds with paper. And we know you are often advised to do it, but the best buyers have not the time to unwrap your goods and look at them.

In shipping dressed poultry in the summer use strong clean barrels, boring three-inch holes in the bottom. Put in a layer of clean excelsior, on this a layer of crushed ice about the size of hen eggs. Then put a layer of chickens in a circle around the barrel. Follow with a layer of ice and a layer of chickens until you reach within four inches of top of barrel. Over the last layer put two inches of crushed ice, over the ice a white woolen cloth, and over all a large cake of ice, so that as it melts it will trickle down through the poultry and reach the market in fresh condition. Put a burlap cloth over the top and fasten with the hoops. Follow these directions and your poultry will reach the market in good order. We use the same method in shipping by express on the hottest summer days to New York City from our buying station 475 miles south of that point. We advise to subscribe for and read the poultry journals. In them you will find many articles of practical benefit, and much that will be of no value. Most of the articles are written by Northern writers for Northern and Western conditions. Some are written in the interest of advertisers who have prepared foods, poultry powders and incubators to sell.

When you wish your birds to win at the fall fairs, about ten days before feed them some sunflower seed and flaxseed meal to increase the brilliancy of their plumage. Feed plenty of beef scrap to redden their combs, and into their mash put some cayenne pepper, ginger and all spice. Be sure to put plenty of Pyrenthrum powder on them to free them from lice.

It is our opinion that the time is coming, and not far away, when every section in Virginia producing a good quality of poultry will have a cash buyer familiar with the modern methods used in handling poultry, and using the same methods that we do in buying direct from the producer, and selling direct to the consumer, and paying for the stock on the basis of its value. It is unreasonable to expect, in this age of progress and fierce competition, that the seller will receive as much for his poor quality, small, dirty, salty, pickled, held—and consequently running a large per cent. rotten—eggs, and black-feathered, poor, runty, hump-backed, scalawag chickens, as those selling fresh, nice sized, clean and bright eggs, and pure-bred meaty poultry. You can search from ocean to ocean, and you will find no section that offers as many opportunities for the profitable production of poultry as does Virginia. You do not have to contend with the long, cold winters of the North and West; you do not have to keep your birds penned up on account of the cold and snow; you do not have to contend with the roop that rages through New England; you do not have the dreaded disease, cholera (except in a mild form), to what they have to contend with south of you. With the excellent railroad facilities your poultry quickly reaches the Eastern city markets, and the Western stuff that is long on the road, will never sell at near the same price that you receive for your fresh eggs and poultry.

New Castle, Va., Nov. 12, 1906.

IRISH POTATO DISEASES.

GENERAL CONDITIONS OF HEALTH.

Considered from the farmers' standpoint the potato plant is a machine for the production of starch, the principal constituent of the potato, together with the small amount of other substances combined with it in these enlarged underground stems, which we use as food. The raw material for the potato substance comes from the soil water, taken up by the roots and the gases of the air. While the sunshine and other conditions are favorable, these substances are organized in the leaves, and gradually pass downward, and accumulate as starch below ground. Since such important work is done by the slender fibrous roots and the expanse of leaves exposed to the sun, the necessity of keeping these organs in good working condition is easily seen. And theoretically one might say that the more water passed through the plant from the roots, and the more sunshine received by the leaves, the more potatoes produced.

The ideal conditions for healthy growth are loose, rich, well-drained, but moisture-retaining soil of moderate coolness, rich in humus, and used in rotation with legumes. Heavy soils are not so good as light and need to have careful management. Constant moisture is the first consideration, but wet soil is equally as fatal to good growth as drought.

Rapid and constant growth gives the best quantity and flavor, though the latter varies with the soil. And the fundamental conditions must be kept up by proper cultivation, especially in the critical period in the life of the potato plant, just after the blossoms appear, when the strength is going into the formation of tubers. If the leaves can be kept healthy then, the life can be prolonged many weeks, and the yield correspondingly increased.

SEED WITH REFERENCE TO HEALTH.

After considering suitability for desired use in earliness, production and quality, the variety planted should be selected for resistance to drought, disease, insects, etc. And if it is desirable to grow one's own seed each season, the stronger, more productive and resistant plants should be picked out for seed, thus keeping up or improving the vigor of the stock. The vigor and health of the plant, which bore the seed tubers, has more to do with their success than the size of the tubers used for seed, or how they are cut.

Partly rotten potatoes or those showing any imperfections, indicating lack of vitality, should never be planted, as they are apt to communicate diseases to those that grow from them, and the cleanest, most healthy-looking seed possible should be used. One poor potato, saved by planting it, is usually equivalent to throwing away a whole hill.

The weakening of the seed by too early sprouting has to be carefully guarded against, and may be done by careful storing. The object of the starch in the potato is to feed the young plants until they can get well-rooted, and they must suffer if it is exhausted by sprouts that are lost before planting. The cut seed may be injured by drying out, or heating, if kept more than ten days before planting. The partly dried pieces withstand rot better if planted in wet soil.

As the country becomes older, parasitic diseases and insects multiply. While in the great potato lands of the West the plant grows luxuriantly, and is but little injured by blight or insects, here these often cause the loss of one-half of what the land would produce without them. And we have become so used to this loss that we do not see the damage, and count this half crop a full crop. The estimated loss from potato diseases in 1904 was 15 per cent. of the crop.

There are several different diseases caused by different germs or fungi. These are often confused, and though usually distinguished as

Entire Healthy Potato Plant (Copy, after Coburn).

blight, rot and scab, there are several kinds of blight, also of rot and scab; each due to a different cause, and often needing entirely different treatment. The following pages give some account of the diseases most common here.

SCAB.

The diseased condition known as scab, causing roughened, scabby surfaces on the tubers, is mostly caused by a minute parasitic fungus, *Oospora scabies*. The fungus also lives in the soil from year to year. Alkaline conditions of the soil favor the growth of the scab fungus, so that lime and plant, [illegible] manure, though valuable in increasing yield, are to be used with caution and, perhaps, are better applied to the previous crop. Lime also favors rot. If the soil to be planted is infected with scab, some green manuring might be sown in the fall, and turned under in the spring, to give acidity to the soil. Experiments in New York, however, failed to show beneficial results from green manuring to reduce scab.

If seed potatoes, free from scab, cannot be had for planting, the seed can be disinfected before planting, by the use of either of the following methods; then if planted in scab-free land, the resulting crop will be practically free from the disease. The seed potatoes may contain scab germs, though they appear perfectly smooth:

1. Two ounces of corrosive sublimate, dissolved in hot water and diluted with cold water to fifteen gallons. Suspend the previously washed uncut potatoes in a coarse sack in this solution for one and a half hours, using a wooden vessel, as it acts on metals. This substance is very poisonous and the treated potatoes should not be eaten by anything. After soaking the potatoes are dried, cut and planted as usual.

2. Mix eight ounces (one-half pint) of commercial formalin (40 per cent.) with fifteen gallons of water, and use as the other solution, but soak for two hours. Formalin is poisonous, but not so dangerous as corrosive sublimate; it also soon evaporates, and does not remain on the tubers as the sublimate does.

Either of these may somewhat retard the germination, and will injure the sprouts that have already started. Fifteen gallons is enough to disinfect twenty to twenty-five bushels. Of course, if the seed is planted in scabby land, the treatment will lose most of its efficiency.

Rolling the cut potatoes in sulphur, before planting, has also been used to control the scab, but is more expensive than the solutions, and is often of little value. The sulphur helps the cut pieces to keep longer, and prevents rotting in prolonged wet weather after planting. Also scattering sulphur in the rows is used by some to destroy the scab germs in the soil, but usually it does little good. Also dipping in Bordeaux mixture has been used.

In Vermont formaldehyde gas has been used with as good success as the liquid formalin to control scab. Its use is often more convenient.

Certain varieties as Cambridge Russett, in particular, and also Carmen No. 3, American Giant, Sir Walter Raleigh, Irish Cobbler, Scab Proof and Aurora, are recommended as resistant to scab.

There are several less common scab diseases caused by other fungi and bacteria.

RHIZOCTONIA.

Small brown bodies, not easily removed by washing, often seen on potato tubers, are caused by a fungus, Rhizoctonia or Corticium. As a rule, they do not seem to cause much damage. But in Ohio a disease called "rosette," causing stunted growth and premature death of the potato plant, is ascribed to this fungus, and in Colorado a trouble called "little potatoes" is found associated with this fungus, which there also attacks the main stem of the plant near the surface of the ground.

The formalin treatment given for scab has been recommended for this; also the planting of clean, well-formed tubers.

DRY ROT.

This disease is caused by a fungus, *Fusarium oxysporium,* which, growing in the stem, causes the plants to gradually dry up and die. The disease is indicated by the lighter colored and more or less rolled up leaves. When dug the potatoes may appear sound, but internally show black or brown streaks, and later are destroyed at least at one end by the dry rot.

The fungus may remain in the soil for a long time, and badly affected land may have to be abandoned for potato growing for several years. The affected tubers should not be used for seed.

BROWN ROT, BACTERIAL WILT OR WET ROT.

This disease is caused by bacteria (*Bacillus solanacearum*), which are introduced into the plant through the bites of the Colorado beetle, flea-beetles, etc., and multiplying cause the leaves and stems to wilt and shrivel, and working down into the tubers cause a wet rot. The same germ attacks egg plant, and causes the Southern blight of tomato, so destructive in the southern part of Maryland.

Very thorough and persistent spraying, using Bordeaux mixture with arsenites to prevent the action of the insects, such as flea-beetles and the common potato bugs, which scatter the germ, and to kill the exposed bacteria themselves, is the best treatment, although not perfectly effective. The affected tubers should be dug early, and if stored they must be kept in a cool, dry place to keep back the rot. In planting avoid land that has recently borne tomatoes, potatoes, or egg plants affected with this disease.

Soft rot or wet rot may develop in potatoes kept in moist and warm places, through the action of various bacteria and fungi. A large percentage of the crop is often lost from wet weather before digging time. This might be obviated by early digging, but there is also danger of rot if dug early and stored, unless some cooling is available. In handling as much bruising as possible should be avoided, as the broken epidermis allows rot-germs to enter.

EARLY BLIGHT.

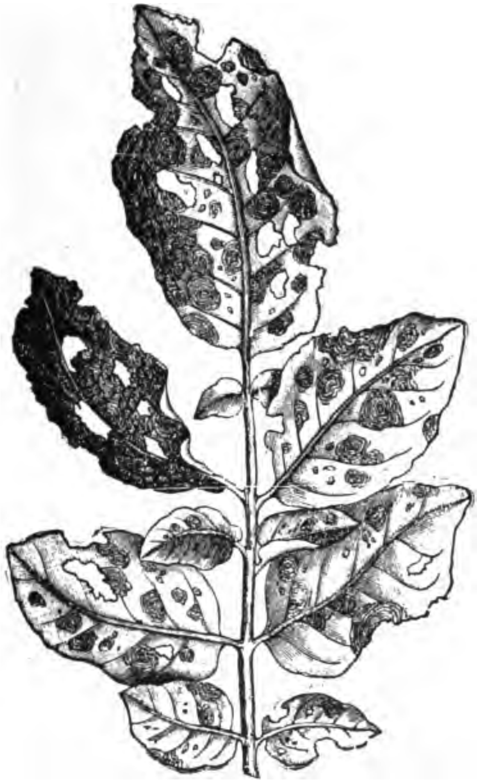
This disease is caused by the growth of the fungus *Alternaria solani* in the spots on the leaves. It appears before or about the time the tubers begin to form, or when anything else lowers the plant's vitality, and is indicated by grayish brown spots, with faint concentric circles like target marking on the leaves. These spots gradually become larger and in ten days half of the leaf may be brown and withered, and the rest of an unhealthy yellow color, though the stems may remain green; or the disease may progress more slowly. Of course, the tubers stop growing as the leaf-surface is destroyed, and the crop is cut short. This early death of the leaves is often so common that it is thought to be the natural ripening of the vines. But when sprayed vines live many weeks longer and produce a much larger crop, the difference is readily seen.

The treatment is thorough spraying with Bordeaux mixture. A mist like spray should be put on all parts of the vine, Paris green being added to kill the insects.

The McCormack potato, now much grown in Maryland, seems decidedly resistant to this disease.

LATE BLIGHT AND ROT.

This is caused by the growth of the fungus *Phytophthora infestans* in leaves, stems and tubers It is generally first seen in moist weather in summer, as suddenly appearing, dark-colored areas on the leaves, which become soft and bad smelling. It sometimes appears so suddenly and spreads so rapidly that a green field may, in two or three days, look like it had been burned over, the blighted leaves dying and leaving the bare stems. It is estimated that in New York this disease caused the loss of $10,000,00 worth of potatoes in one year. The disease may later appear in the tubers causing them to be black and brown streaked and to rot. Other diseases may cause similar affects on the tubers.



Early Blight (from Galloway, Farmers Bulletin 91, U. S. Department Agriculture.)

This disease is not commonly destructive in Maryland, as the summer temperature is not usually sufficiently low for a long enough time for the development of the parasite, though it has caused serious loss in many parts of the United States since 1840, and has been destructive at times as far South as Florida, being no doubt introduced on Northern seed.

The treatment is preventative spraying with Bordeaux mixture and avoiding the planting of decayed or discolored tubers, which carry the disease over winter. Deferring digging as long as possible reduces loss from rot in storage. The average increase due to spraying for this disease for fifteen years in Vermont is 119 bushels per acre, or 68 per cent.

The investigations of Jones show that although no varieties are proof against this disease, some are much less affected by it than others. Early varieties may mature soon enough to escape the disease, but if planted late may blight worse than others. Highly nitrogenous fertilizers lower resistance to late blight. Varieties rich in starch, rot less from late blight than those rich in protein. Those with red, thick, rough skin rot less than thin-skinned white varieties. Varieties with hard, rough stem and small, rough, dark-colored leaves blight less. Some of the American varieties less subjected to blight are Dakota Red, Rust-proof, Irish Cobbler, Sir Walter Raleigh, Doe's Pride and White Beauty, and some others not so thoroughly tested that have recently been introduced.

INJURIES NOT CAUSED BY PARASITES.

The internal brown spot disease frequently noticed in the flesh of the tuber is apparently not due to parasites, and may be due to cultural conditions, being worse on light, dry soils or those lacking lime and potash. Some varieties seem more susceptible to it. It would be better not to plant potatoes so affected.

The leaves are often injured by weather conditions, and effects similar to early blight produced. Dry, hot weather with lack of water in the soil will cause *tip burn,* which is the death and drying of the leaf margins, and sometimes spots away from the leaf edge, especially where punctures of flea-beetles have caused loss of water. Too deep late culture will induce it. The name *sun-scald* is applied to similar effects due to hot sunshine after a period of wet, cloudy weather.

Plants in good, well-cultivated soil and sprayed with Bordeaux mixture are less liable to tip burn. Irrigation would be helpful when it could be practiced.

The leaves are frequently injured by poisoning with Paris green, applied dry, or even with water only, giving an effect resembling early blight, especially where flea-beetles occur. By using the arsenical poisons with lime-water, or better Bordeaux mixture, this injury is obviated, as well as great benefit gained from the protection against fungous diseases which the Bordeaux affords. Many farmers use Paris green alone in a very wasteful and injurious manner, and frequent cases of supposed blight are nothing but Paris green injuries. One pound per acre at each spraying is enough.

Light causes a somewhat poisonous substance, found also in sprouted potatoes, to develop in the outer layers of the potato; such tubers turn greenish and are strong flavored, and unfit for food.

Frozen potatoes have a sweetish flavor, due to the conversion of some starch into sugar.

NOTES ON SPRAYING POTATOES.

Many tests have shown that the best material for spraying potatoes for leaf diseases and insects is Bordeaux mixture containing Paris green. It may be made as follows:

Five to six pounds copper sulphate (blue stone), dissolved in twenty-five gallons of water; four to six pounds of fresh stone lime, slacked as for white-wash in twenty-five gallons of water; one to two pounds Paris green; mix thoroughly and use fresh.

The useful part is the copper, the lime is added to prevent its injuring the foliage. The best mixture is that which settles out most slowly. It is best made by taking the cold diluted milk of lime and copper sulphate solutions and pouring them together through a strainer into the sprayer. The Paris green can be added at the same time.

Properly made Bordeaux mixture is of a brilliant sky-blue color, or lighter as more lime is added. If the lime is poor, it will have a greenish cast. If there is insufficient lime in the mixture, it may injure the foliage. A test of this can be made by dropping a little yellow prussiate of potash (very poisonous) into the mixture. If the drops turn reddish brown, add more lime until the test repeated shows no change. A considerable excess of lime will do no harm, and is neccessary for spraying some sensitive things like peach foliage. Blue litmus paper can also be used as a test; it turns red if there is not enough lime in the mixture.

When spraying is done on a large scale "stock solutions" of the copper sulphate and lime should be made up by adding one pound of lime to each gallon of water in the lime stock barrel, and one pound of copper sulphate to each gallon in the copper sulphate stock barrel. These will keep indefinitely if not allowed to evaporate, and the mixture can be easily made by taking as many gallons of each as the formula calls for pounds, and dilute and pour together as before.

If one has a suitable water supply, pipes and faucets to barrels on an elevated platform can be arranged to save labor of handling the liquids. They can also be piped together into the sprayer and thus mixed, if always first diluted.

The ordinary barrel pump, costing about fifteen dollars, is one of the best arrangements for potato spraying, one man pumping and driving the cart or wagon, and two others working the nozzles. Or with a little more expense a set of pipes, with nozzles attached, in the proper position to spray four rows at a time, can be arranged so that one man can do all the work, though less effectively; for larger fields geared pumps of similar structure to the last mentioned are used, and the labor is done by the horse, but they are more expensive ($60 to $75), and do less careful work. It is essential to good work to have a pump and nozzle that will make a fine mist, and not simply sprinkle the plants.

Spraying probably would not be very profitable here on early potatoes. Wherever late blight does damage it would pay well. Three years test of spraying potatoes at this Experiment Station showed an average increase of 52 per cent. on the sprayed fields, spraying three or four times from June to September. On late varieties when no blight was present, experiments in New York show a net profit of $11 per acre, when potatoes were only twenty-five cents per bushel.

It will cost $4 to $6 per acre to give five applications of the spray per season to potatoes. This includes labor for man and team and wear on sprayer, labor being estimated at seventeen and one-half cents per hour, which is more than is usual in this State. Here we could usually spray at a cost of less than one dollar per acre for each spraying. Labor is the principal expense, after the spraying outfit is secured, as the materials cost comparatively little.

As a general rule commence spraying when the plants are six to eight inches high, and give four to five sprayings at intervals of about two weeks. When the blossoms begin to come the plants should be kept covered with Bordeaux mixture until they have completed their growth.

The application of Bordeaux mixture, aside from preventing parasitic diseases and repelling flea-beetles, causes the plants to make a better growth, probably by protecting the foliage from the intense summer light and heat, and so is of value even when no disease is present.—*Maryland Experiment Station Bulletin No. 108.*

One acre of good cow pea hay will make as much protein, the muscle and milk-makers, as two tons of wheat bran, and at one-half the cost, and the land is better after growing the peas than before.

SEED OF RED CLOVER AND ITS IMPURITIES.

Many Farmers Make a Serious Mistake by Purchasing Cheap Clover Seed.

Red clover (fig. 1) is the principal leguminous crop of the United States, although the cultivation of alfalfa is increasing rapidly. At the time of the last census there were approximately four million acres in red clover and two million acres in alfalfa. Red clover, appearing as it does in rotation at intervals of three to five years on the greater part of the best agricultural land of this country, plays a most important part in the maintenance of successful agriculture, and consequently special attention should be given to the quality of seed used.

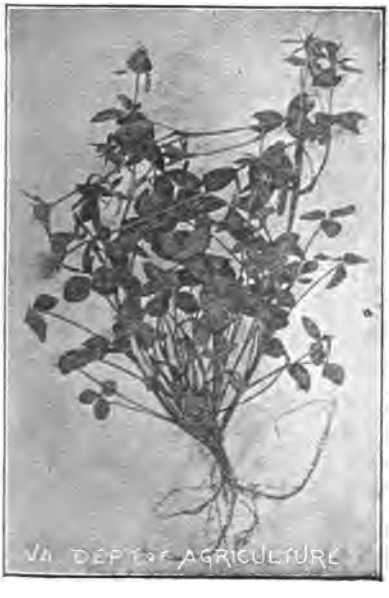


Fig. 1.—Plant of red clover.

THE SEED QUALITY.

Red clover seed of good quality is of large size, dark colored, has a decided luster, and is practically free from weed seeds. Red clover and timothy seed are sold in more grades than any other seeds, all of the large dealers offering from five to ten qualities at a time. Among these grades will be found seed that is practically free from weeds and dirt, germinating 95 to 98 per cent., as well as screenings made up of small, light-colored or shriveled brown seed with a large percentage of weed seeds, including dodder and many other noxious weeds. These extremes are well represented by the analyses of the two following samples:

Sample No.	Pricepaid per 100 pounds.	Percentage of weed seeds.	Percentage of dirt, sticks, and stones.	Percentage of red clover seed	Percentage of red clover seed that germinated.	Number of weed seeds per pound.	Actual cost per 100 pounds of red clover seed that germinated.
1..........	$ 5.20	25.78	6.16	48.06	18.26	139,727	$28.48
2..........	15.00	.09	1.08	98.83	95.86	150	15.65

Sample No. 1, imported at 5 1-5 cents per pound, contained about 18 1-4 per cent. of red clover seed that would grow, and most of this was small, light seed that would not produce vigorous plants. Large quantities of seed of this grade are constantly being imported. The quality of such seed is so poor that it is not often sold alone; neither is it recleaned, as the good seed it contains actually costs more than the best quality of seed. None of this poor seed is imported to be wasted, but it is mixed in varying proportions with better seed and sold to the farmer.

Sample No. 2 contained more than 95 per cent. of red clover seed that would grow, and was practically free from weed seeds. In order to sow the same amount of good seed from these samples, it would be necessary to sow 5¼ pounds of the poor sample to 1 pound of the other. Every time 150 weed seeds were sown with the good sample, 733,567 weed seeds would be sown with the poor one.

SIZE.

Red clover seed varies greatly in size, this being to a large extent a good indication of quality. In average seed grown in the United States there are about 300,000 seeds to the pound. English seed is somewhat larger, having about 220,000 seeds to the pound, while Chilean seed is much larger, having only 190,000 seeds to the pound. There are frequently imported large lots of screenings similar to sample No. 1 referred to above, which are made up of light-colored clover seed, very small in size, there often being as many as 490,000 seeds to the pound.

IMPORTED SEED.

The United States is a large exporter of clover seed, our annual sales ranging from 5,000,000 to 30,000,000 pounds per annum. At the same time we are importing relatively smaller quantities of seed of lower quality. In most European countries there is some sort of seed control, either voluntary or otherwise, by means of which the people have been educated to the use of seed of good quality. This leaves a large bulk of poor seed that cannot be sold there, which, being offered for export at low prices, is sent to the United States and either sold as low-grade seed or, in case it is especially bad, mixed with other better seed in the so-called grading-down process before being put on the market.

A very stringent seed law has recently been enacted in Canada, prohibiting the sale there of seed containing more than a very small number of weed seeds. It contains the following clause:

"The provisions contained in this act shall not apply to seed marked 'not absolutely clean,' and held or sold for export only."

While the provisions of this law prevent the local sale of screenings or seeds containing weeds in quantity, it encourages the exportation of such seed from Canada.

As a result of the conditions in Canada and Europe the United States, where quality is not considered as carefully as it should be and where there are no restrictions on the sale of poor seeds, becomes a ready market for low-grade seed.

That this low-grade seed is not imported for the purpose of recleaning is shown by the fact that in samples like No. 1 previously referred to the red clover seed which will grow costs nearly twice as much as the best clover seed offered on the market, notwithstanding the fact that this sample was imported at 5 1-5 cents per pound.

Chilean red clover—Last year about 275,000 pounds of Chilean red clover seed were imported. This is especially fine-looking seed on account of its dark color and extremely large size. It has not been given a thorough trial in the United States, and it is not certain how successful it will prove. It should, however, be carefully examined, as all of this seed which has been imported has been found to contain large quantities of a large-seeded dodder, which may prove to be a destructive clover parasite in the United States.

THE DEALER'S PROFIT ON LOW-GRADE SEED.

A large part of the seed dealer's profit is derived from the sale of screenings and low-grade seeds. At the present time, when good seed is selling for about 15 cents per pound, from 3 to 10 cents is paid for screenings, which are mixed with better grade seed in making the various qualities offered by the seedsmen. This condition of affairs is largely due to the farmer's demand for cheap seeds, and it must be expected that seedsmen will meet this demand.

ADULTERATION.

Red clover seed is not adulterated as often as alfalfa, Kentucky bluegrass, and orchard grass seed. Several samples, however, have been examined in the Seed Laboratory of the Bureau of Plant Industry which have been adulterated with from 20 to 40 per cent. of yellow trefoil seed. Yellow trefoil is not cultivated in the United States, but the seed is imported in large quantities from Germany for the express purpose of use as an adulterant of alfalfa and red clover seed. A few firms are apparently responsible for all the adulterated seed of this description which is offered for sale in the United States.

MAMMOTH OR SAPLING CLOVER.

Although mammoth clover is very distinct from the common red or June clover in its habit of growth, coarseness, and earlinesss, the seed cannot be distinguished from that of the common red clover. It is supposed to be slightly duller, but this is an unsafe distinction to make, and the purchaser must rely entirely on the dealer in buying mammoth clover seed.

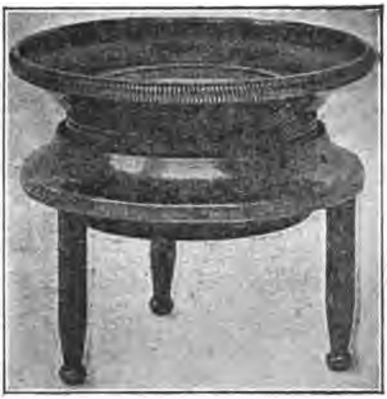


FIG. 2.—Magnifying glass.

HOME TESTING OF SEED.

Every farmer should have some kind of a magnifying glass. A convenient and cheap form is a tripod lens, which costs from 25 to 50 cents (fig. 2). A sample of seed should be thoroughly mixed and about a tablespoonful spread out on a sheet of white paper. By looking this over carefully under the lens most of the weed seeds and dirt can be separated from the red clover seed. In this way the proportion of good seed can be estimated. Care should be taken that yellow trefoil seed is not mistaken for red clover seed.

The percentage of seed that will grow can easily be determined by means of the simple test shown in figure 3. Two dinner plates and a piece of canton flannel or some other similar cloth about twice the size of the plates are needed for this test.

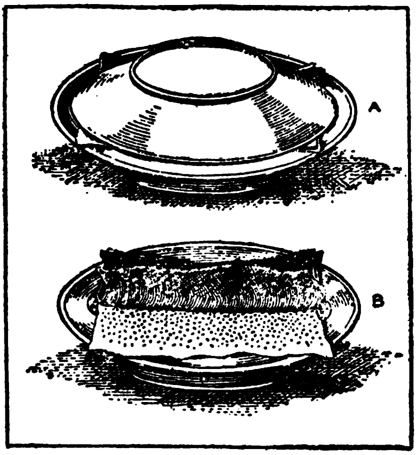


FIG. 3.—Homemade seed tester. A, closed; B, open.

Mix thoroughly the red clover seeds which have been picked out and count 100 or 200 seeds just as they come, making no selection. Moisten the cloth well; lay one thickness on one of the plates, put the counted seeds on the cloth, lay the rest of the cloth over the seed and cover with the second plate, and keep at a temperature of about 70° F. On the second and each succeeding day take out and count the sprouted seeds. In from four to six days all of the good seeds will have germinated, indicating the percentage of seeds that would grow when the seed was sown, provided all the conditions were favorable.

SEED TESTING BY THE UNITED STATES DEPARTMENT OF AGRICULTURE.

The Seed Laboratory is prepared, as far as facilities permit, to examine without charge red clover and other seeds for the presence of adulterants or dodder, and to make tests both for germination and for mechanical purity. The test for mechanical purity consists in determining the percentage of pure seed and of weed seeds, including dodder. All samples sent for testing should be not less than two ounces in weight, should be addressed to the Seed Laboratory, U. S. Department of Agriculture, Washington, D. C., and should be accompanied, as far as possible, by the following information: Name and address of seller, year and place of growth, price paid, and name and address of sender.

CHANGE OF SEED.

Up to the present time little attention has been paid to local varieties of the common grasses and forage plants, although it is well understood that changing the seed of grain from one locality to another has a marked effect on the crop.

The Department of Agriculture is now conducting a series of experiments to determine the effect of sowing red clover seed from one region in other regions having different conditions of climate and soil. About 400 acres of land are now under cultivation in carryig on these experiments. This work is being done in 20 typical red clover sections in the United States, about 20 acres being used in acre plots in each place, each single acre being seeded with seed from a different locality. The results from the first two years' work have shown striking differences in yield, earliness, and seed production in red clover from different regions.

It is believed that as a result of this work it will soon be possible to recommend types of red clover which are especially adapted to culture in particular localities.

WEED SEEDS IN RED CLOVER SEED.

A considerable part of the impurities of red clover seed consists of weed seeds. Their presence is either incidental or intentional. Their incidental occurrence is due primarily to the weedy condition of clover meadows, by reason of which weeds maturing with the clover are harvested with the seed crop. Weed seeds qualified by size and weight to accompany the clover seed through the huller and cleaner will then appear in the recleaned seed in quantity proportional to their abundance in the field and the extent to which the clover seed is recleaned.

A long list of seeds liable to appear in commercial red clover seed is thus formed. As yet no single seed-producing locality contributes even a majority of the seeds of such a list, but owing to the wide-spread interchange of seed in commerce and the consequent introduction of new weeds the number to be found in any one locality is constantly increasing.

This process of weed distribution is slower than it otherwise would be, owing to the inability of certain weeds to thrive or produce seed in many localities into which they are introduced until they have passed through a period of acclimation. In the case of some weeds, however, the conditions are reversed, resulting in greatly increased productivity of plants in their new surroundings.

The most effective means for counteracting this progress of undesirable plant growth appears to lie (1) in the use of clover seed as free from weed seeds as possible, and (2) in the employment of special efforts to rid seed-producing meadows of such weeds as contribute to the impurity of the seed crop.

A knowledge of weeds and their seeds is a primary requisite to carrying out these suggestions. In the following pages some of the more important weed seeds likely to be found in red clover seed are described. Some effort is made to draw a distinction between the seeds of plants already well established in this country and some of those still found only in imported seed. This is to meet a general demand for a means of identifying home-grown seed, so that it can be purchased instead of imported seed. The presence in clover seed of weed seeds distinctively American is a strong indication of the American origin of at least a part of the seed. Likewise the presence of weed seeds distinctively foreign, so far as we are aware at present, is indicative of the foreign origin of at least a part of the seed.

First-class red clover seed should contain very few weed seeds. This means at most but a few hundred and should mean less than 100 in each pound. Even this seems a large number, but clover-seed production has not yet received that special attention which insures perfectly clean seed, and a few hundred weed seeds per pound constitutes a small number when compared with the thousands and tens of thousands of weed seeds per pound found in many samples of commercial red clover seed. In a series of tests covering 163 samples of red clover seed made in Canada in 1902, but 2 samples contained less than 100 weed seeds per pound, and but 32 contained less than 1,000 per pound. Many of them contained from 10,000 to 40,000 weed seeds per pound. Even very small commercial samples wholly free from weed seeds are extremely rare.

IMPURITIES IN AMERICAN-GROWN RED CLOVER SEED.

Considering first the condition of seed grown in this country, we find that of the list of from 50 to 70 kinds of weed seeds which will be represented in as many samples of red clover seed from different localities some kinds are likely to be present in a considerable number of the samples, others are apt to appear in over half of them, and a few are likely to be present in nearly every sample. The kind which predominates is largely dependent on the locality from which the seed comes. For instance, Canada thistle seed is not generally common in red clover seed, yet in Bulletin No. 8, of the Canadian Department of Agriculture, previously referred to, this seed is reported as found in more than 23 per cent. of the 163 samples examined.

The size of the clover seed, depending upon the locality where grown, the character of the growing season, and the extent of the cleaning it has received, has a marked influence on the kind of weed seeds carried by it. Thus, oxeye daisy seed, which is sometimes found in small, poorly cleaned seed, is seldom present in large, well-cleaned seed. It is quite possible that the variety or strain of red clover (not now recognized by name) has much to do with the size of the clover seeds and therefore with the relation of weed seeds to such seed.

IMPURITIES IN EUROPEAN-GROWN RED CLOVER SEED.

The seed of red clover grown in Europe is subject to the same general conditions respecting weed seeds which prevail in this country; but the fact that some European seed is smaller than American seed renders it liable to contain weed seeds not likely to appear with larger seed even of foreign origin. Such seed seems to be a rather popular means of adulteration of better seed, and often appears on the American market. Many kinds of small weed seeds are brought into this country in this way, the importation of which would be prevented if the legitimate cleaning and marketing of fair-sized seed were given proper attention.

With respect to foreign-grown seed it may be considered fortunate that some of its weed seeds are those of plants which do not thrive, or at least do not fruit abundantly, in this country. Clover dodder (*Cuscuta epithymum Murr.*) is an excellent and important example of a plant conspicuously injurious and fruiting abundantly in Europe; yet, while it is equally injurious here wherever it secures a foothold, according to the best information obtainable it produces no seed in most instances.

DESCRIPTION OF THE SEED OF RED CLOVER.

The following description of the seed of red clover (*Trifolium pratense* L.) may be useful in comparing it with certain impurities, particularly yellow trefoil seed. Red clover seeds vary considerably in size, form, and color. Their length varies from nearly one-tenth to one-twentieth of an inch. Bulk seed of average size contains very few of these smaller seeds. The form generally is triangular, with rounded angles and unequal sides. Two of the sides are convex, the other, including the scar of the seed, partially concave. The color varies from deep violet to light yellow. Some seeds are violet throughout; others entirely light yellow; some present both colors. The surface is smooth and in fresh seed has a slight diffused

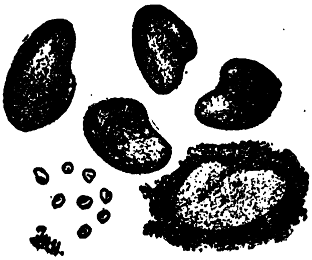


FIG. 4.—Seeds of red clover, enlarged and natural size.

polish. Old dead seeds lose the fresh violet and yellow colors and assume a dull brown color. (Fig. 4.)

DESCRIPTIONS OF WEED SEEDS MOST COMMONLY FOUND IN RED CLOVER.

The following kinds of weed seeds are those most likely to be found in any sample of red clover seed offered for sale. Some of them, when their presence is incidental, are never found abundantly.

It is hoped that the illustrations, together with the descriptions, will enable the reader to distinguish these seeds as they are found in clover seed. The descriptions emphasize the principal characteristics of the seeds. Since these seeds are all impurities of clover seed, it is evident that they do not differ greatly from average clover seeds in size and shape. Reference to their size in comparison with clover seeds is therefore given to assist in their ready detection.

YELLOW TREFOIL.

The frequent use of the seed of yellow trefoil (*Medicago lupulina* L.) as an adulterant of red clover seed makes it one of the first kinds to seek in examining a sample of commercial seed. Its identification, which is the important step, is readily accomplished with an ordinary lens, dependence being placed on the color and characteristic form of the seed. The surface of bulk seed which has been heavily adulterated assumes a greenish hue not seen in pure red clover seed.

Yellow trefoil seeds are essentially the same size as those of red clover. Their color is generally greenish yellow in fresh seed, becoming brownish in older seed. They never have the violet color of red clover seeds, and the lightest colored seeds are not so light yellow as the clover seed. Many of the trefoil seeds bear a light-colored stripe extending on each side from the scar toward the broader end. Trefoil seeds are in general oval, while those of clover are triangular. The tip of the rootlet of the embryo rests within a more or less prominent

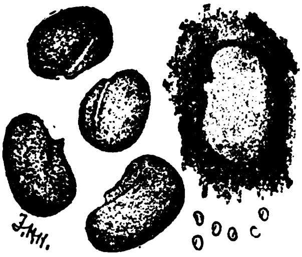


FIG. 5.—Seeds of yellow trefoil, enlarged and natural size.

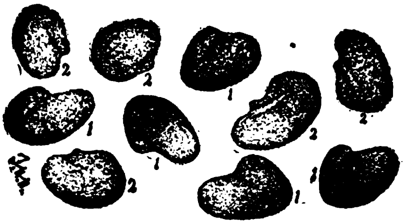


FIG. 6.—(1) Seeds of red clover, enlarged.
(2) Seeds of yellow trefoil, enlarged.

projecting point beside the seed scar in the trefoil, while in the clover seed the corresponding portion is broadly rounded, forming one of the three rounded corners of the seed. (Fig. 5.) Seeds of clover and trefoil are shown together for comparison in figure 6. The seeds marked 1 are clover; those marked 2 are trefoil.

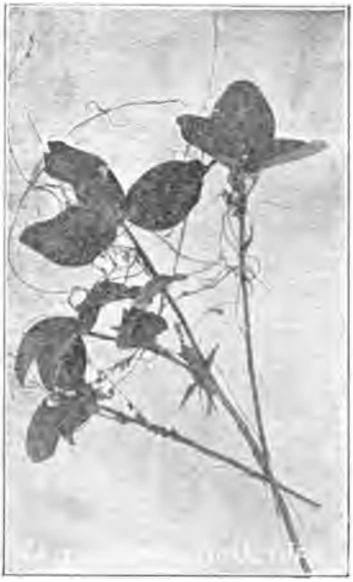


FIG. 7.—Field dodder growing on red clover.

DODDER.

The pernicious parasitic plant known as dodder (*Cuscuta* spp.), an illustration of which appears as figure 7, is apparently becoming more common in this country, its seed having recently been found in 116 out of 521 samples of commercial red clover seed examined. Its frequent occurrence is no doubt largely due to the use of imported low-grade seed. Two kinds of dodder seeds are apt to be found in red clover seed in the American market.

Clover dodder—The seeds of the well-known clover dodder of Europe (*Cuscuta epithymum* Murr.) are confined almost entirely to European-grown clover seed, since the plant generally does not produce seed in this country. The seeds are much smaller than red clover seeds, being about one-twentieth of an inch or less in diameter. Their small size should prevent them from being held in red clover seed, but they are often abundant in small-seeded imported seed. They are oval and but slightly flattened, or are nearly spherical. The color is light brown or dark brown, sometimes ashy gray. The surface is finely roughened and often is abundantly pitted as seen under a lens. Minute particles of clay which have become rounded often look remarkably like these dodder seeds. They crumble to dust, however, under slight pressure.

Dodder seed under question as to identity may be boiled for some time in water, when the characteristic slender coiled embryo will emerge from the seed coat.

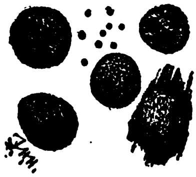


FIG. 8.—Seeds of clover dodder, enlarged and natural size.

The seed of clover dodder should be entirely removed from seed by the careful use of a sieve having a mesh not smaller than one-eighteenth of an inch. Comparatively little first-class clover seed will pass such a sieve. A small sieve of this kind is very helpful in testing for this dodder when present in small quantity. (Fig. 8.)

Field dodder—The seed of field dodder (*Cuscuta arvensis* Beyrich) sometimes appears in clover seed and in some instances may be very abundant. It is a native kind which grows profusely and produces an abundance of seed. The seeds are considerably larger than those of clover dodder and so cannot be entirely removed from seed without considerable loss, and only then in the case of the largest clover seed. This seed might very properly be more dreaded in this country than the notorious clover dodder of Europe. The largest of the seeds are about the size of the smaller clover seeds, a considerable proportion of this kind being smaller. They are yellowish, light brown, or grayish, and somewhat flattened. One face is rounded, the other angular, usually showing three unequal areas meeting at the angles. The surface is dull, finely roughened, but not pitted. (Fig. 9.) A sieve is useful in determining the presence of this dodder.

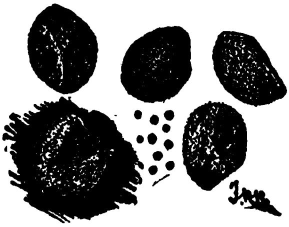


FIG. 9.—Seeds of field dodder, enlarged and natural size.

Chilean red clover is very likely to contain another kind of dodder, whose seeds, aside from the fact that they are usually darker colored, are practically indistinguishable from those of field dodder.

Dodder in the clover field is such a pernicious pest that none of its seed should be sown on the farm, and clover seed should be thoroughly examined and its purity assured before it is sown.

BUCKHORN, RIB-GRASS, OR ENGLISH PLANTAIN.

The seeds of buckhorn, also known as rib-grass or English plantain (*Plantago lanceolata* L.,) are somewhat longer than average red clover seeds, but about the same width. They are oblong, rounded on one face, the other having a deep groove between the rounded infolded edges of the seed. The scar is within this groove. The surface is usually smooth, shining, and light brown.

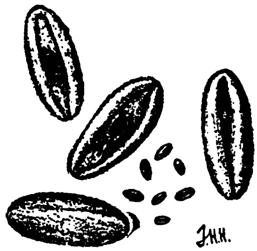


FIG. 10.—Seeds of buckhorn, enlarged and natural size.

This is one of the commonest of the weed seeds found in red clover, most of which could be removed by proper cleaning. It appears as frequently in imported seed as in that grown in this country. (Fig. 10.)

SORREL, OR SHEEP-SORREL.

The seeds of sorrel, or sheep-sorrel (*Rumex acetosella* L.), usually covered by their reddish-brown floral envelopes, are about the size of the smaller red clover seeds. They are common in low-grade small seed, but very few should appear in well-cleaned large-seeded grades.

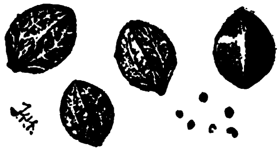


FIG. 11.—Seeds of sorrel, enlarged and natural size.

Sorrel is so widely distributed that its seeds may be looked for in seed from any source. They are oval, bluntly three-angled, and reddish brown, either with or without the floral husk. With this husk removed the seeds are smooth and usually highly polished.

CURLED DOCK.

The seeds of curled dock (*Rumex crispus* L.) vary in size to the extent that the largest are somewhat longer than the largest red clover seeds, while the smaller ones are smaller than average clover seeds. Only the smallest are removed in recleaning red clover seed. These seeds are readily recognized, as dock seeds at least, by their sharply three-angled form and lance-like outline as they lie on one of their three equal faces. They are reddish brown and the smooth surface is more or less polished and shining. (Fig. 12.)

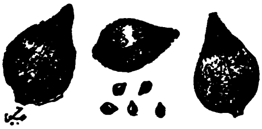


FIG. 12.—Seed of curled dock enlarged and natural size.

The seeds of a closely related and equally injurious dock (*Rumex obtusifolius* L.) often occur with those of curled dock, from which they are almost indistinguishable.

HOW WE GROW POTATOES IN THE VALLEY.

First we select a good piece of upland sod, clover preferred, but if we have not that, we take timothy. We try to manure it well during the winter, plow it as early as we can in the spring and put it in first-class condition.

Seed—We do not use seed that has been sprouted to any extent, but want good sound potatoes, smooth and free from scab. We cut these into chunky pieces containing from one to three eyes according to the size.

Having the ground well prepared we plant as early in April as we can, always planting before we plant corn. Some of us use the potato planter and think it a great machine, not only a great labor saver but we have demonstrated that we can raise more potatoes per acre by the use of one than if planted by hand. One is sufficient for two or three neighbors. If it is not convenient to use a planter, score out the rows about three feet apart, sow in the row a hand full of good fertilizer to about two steps or six feet. This will give you about 600 pounds of fertilizer to the acre, and I would not sow less; if anything, more. After sowing fertilizer in the row, run the single shovel through the row again, which thoroughly mixes the fertilizer with the ground and deepens the row; now drop the seeds, one piece in a place and about eighteen inches apart. Cover the seed at least four inches deep, by running the single shovel on both sides of the row.

Mr. Sproul gathering his potato crop; yield 300 bushels per acre.

Fertilizer—We used this year several brands of potato fertilizer already mixed, also a mixture of our own, and found that our mixture produced as well and cost several dollars per ton less than either of the mixtures. Our mixture was seven hundred pounds of dissolved animal bone, seven hundred pounds of sixteen per cent. South Carolina, four hundred pounds of tankage, two hundred pounds of sulphate of potash. If the soil was not a clover one, we would add more nitrogen; if the soil is a sandy or gravely soil, we would use more potash. Our land is a heavy clay soil and has a good deal of available potash and we have found that two hundred pounds per ton has given us about as good results as more.

Cultivation—We try to harrow as soon after planting as we can; then once again before the potatoes come up. As the potatoes are coming through the ground, we run over them with the weeder once or twice until they are large enough to plow; we then start the double sulky cultivator, plowing right deep the first time, as in corn; afterwards cultivate shallow. We try to go over the potato land as soon after rains as the ground will permit to keep it from forming a crust. After the potatoes are too large to cultivate with the double sulky, we plow over once or twice with the single five tooth cultivator, running once through the middle of the row.

Spraying—We use the four row sprayer, operated with a horse and driver, if we are bothered with bugs, which however is a very rare thing. We use one-fourth to one-half pound of Paris Green in the Bordeaux Mixture and one or two sprayings is sufficient to clear them out.

Blight—We are not usually troubled with blight, but believe it is safer to spray with Bordeaux from two to four times and that it will pay in the long run. Begin spraying when the plants are about six inches high and continue at intervals of eight to ten days.

Digging—We usually use a single shovel plow with a broad shovel to plow them out and try to get a half dozen of boys and girls to do the picking up. We scatter empty flour barrels along the rows at short intervals. When filled these are set in the wagon bed and hauled to the barn where we keep them until we are ready to haul them to market. In this way the digging and housing can be rapidly done and at a smaller cost than if all grown help is used, besides being easier gotten.

Varieties—We have found the Carman No. 3 and Dutton the most profitable varieties in our section. We only grow the late variety for winter use. A few years ago we thought we could not raise potatoes except in the garden and often did not raise enough to do our family through the winter, but by experimenting we find that we can grow from 125 to 250 bushels per acre. The little cut shows our crop of this year, which measured 250 bushels per acre. Nearly every one in our section now puts out from two to ten acres of potatoes, and finds it the most profitable crop that they can grow. We believe there is no need for our people to have to go to New York or Michigan for their potatoes, as it is proven beyond a doubt that our potatoes are better to eat and are as fine keepers as those gotten from other States.—*W. W. Sproul, Middlebrook, Va.*

QUALITY EVEN IN THE ONION TRIBE.

My ideal good onion is one that is either oval or spherical in shape, compact and firm, with small, short neck. It must be of good, clean appearance, with an evenly colored, thin, unbroken skin. The flesh must be mild and crisp, and long keeping.

Thick-necked bulbs do not keep so well as those with thin necks. You cannot always grow thin necks, however, and though the stock of the seed may have something to do with this, still the trouble is not one that can be surely controlled.

Onions grown on a rich and fertile soil, in a climate warm and equable, are sweetest and mildest in flavor—so much so that they can be eaten out of hand, like an apple, raw.

HOW TO GET THE BEST ONIONS.

To obtain the best quality in onions, they must be grown with scrupulous care as to fineness and richness of soil. You cannot get any sort of well-shaped bulb in a rough coarse soil.

Onions thrive best in a very rich soil, firmly trodden down, allowing only about three inches loose on the top, to plant them in. As a rule, seed is sown thinly in the open ground, where the plants are to grow, and the plantlets thinned as necessary. If sown in the fall (November) they give an early crop of "bunch" or "spring" onions, and are then especially welcome as salading, being one of the first of the refreshing raw "green stuffs" ready after the heavy winter fare.

Onions that have run to flower are useless for storing. Bend over the tops, so as to break the neck before it has grown too far.

Under what is called the "new onion culture," the seeds are started in heat in the early spring (January and February) and transplanted outdoors, after danger of frost is past, the young plants being gradually hardened off first. They must not suffer any check when transplanting, the secret of success in this system being to keep the seedlings growing right along, otherwise the bulbs will not keep well. In either case weeding must be done systematically and cultivation begun early and kept up all the time. And remember, one of the worst weeds in the onion bed is likely to be—onions! Give them plenty of room.

When the onions are ripe, the tops will give signs by falling and bending prior to decay. At that time go over the bed, breaking the top at the neck. This causes the onion to "plump up," becoming firm and compact, and consequently improving its keeping qualities. Toward the end of September the bulbs are dug or pulled up, and left on the ground, exposed to the air, for a day or two if the weather is dry; but do not leave well ripened and well dried bulbs outdoors to get wet, as they will start growing again. If this happens, their keeping qualities are ruined.

The giant Spanish onion, pale yellow, sometimes four inches in diameter, like most mild-flavored ones, does not keep well. Prizetaker, the American form of this, is the best all-round onion for home use.

The easiest, and perhaps the best, way for the home gardener to follow in growing onions is to use sets which may be bought at the seed stores. These are small onion bulbs, specially grown. Seed is sown later than for the regular crop that is to mature this year—generally about the end of May—and seeding is thick, so as to crowd the young plants, and a sandy, inferior soil is selected. The whole idea is to raise a small, solid bulb that will keep over winter, for replanting in the spring. The small sets are harvested in August, and kept exactly as are the large bulbs. The smaller the set, the better, although for home use the matter of size is not important. Overgrown sets are used as pickling onions. The light skinned varieties are preferred for this purpose, the White Globe being a special favorite.

PROBLEMS OF KEEPING.

It is no use trying to keep soft, growing onions. They simply will not keep. The red-skinned varieties are the best keeping. The yellow skins rank next; then the whites. After digging and drying for a few days the bulbs are put into a cool, dry, well-ventilated cellar or store room. See that the bulbs are perfectly ripe, and quite dry. An excellent way to keep them is to tie them in "hanks," and hang them up. To tie, use raffia; beginning at one end, tie in a cylinder-shaped bundle, eighteen inches to two feet in length, finish with a loop, and hang up. Thus treated, and suspended from the roof, they are out of the way, leaving shelf room for other things. Never pack in deep bins or piles. Handle them just like other bulbs, allowing plenty of air to play around. Look over the stored bulbs from time to time, and pick out bad ones, so as to prevent the disease from running to the others. Scallions—onions that are all neck and no bulb—are useless for storing.

Chives, the dwarf member of the family. The green leaves, chopped fine, are used in salads. Will grow well in a sunny window.

PREPARATION FOR THE TABLE.

The strongest-flavored onions are best used for seasoning and sauces. Use the white onions for white soups and sauces, the red and yellow varieties for brown sauces, and for any dish where color does not count, and for frying.

The characteristic quality of the onion—its flavor and odor—is due to a pungent essential oil, and to a certain degree, paradoxical as it may seem, the table quality of an onion is in inverse ratio to the quantity of this oil. Some housewives use onions as little as possible, just because of the discomfort incidental to their preparation. But it is very easily overcome: peel the onion while it is immersed in cold water—hold the hands, knife and onion under the water. True, this is a somewhat awkward proceeding, but it entirely does away with the painful watering of the eyes. This same oil makes onions indigestible to some people, but even that can be overcome by extracting the oil. To modify the strong flavors, parboil or scald the bulb before cooking it. This removes the acrid oil without detracting from the flavor. To parboil, plunge the peeled onion into boiling water, and boil for five minutes. The green oil-laden water is then thrown away. As onions thus treated are softened, they will not fry well—all things must be free from water for satisfactory frying, so if you wish to have "browned" onions, do not parboil, but "scald" instead. Peel and put them into a bowl, pour boiling water over them, cover, and let stand for five minutes. This draws out the oil without softening the tissues.

A hank of American garlic ready for storage. Garlic is really palatable only when grown in a hot climate. In cold regions it is overpungent and acrid.

The onions of the stores are often very strong. Those with a green color running through them are always markedly acrid, and may require two or three waters.

The best way of cooking so as to retain all the flavor and richness of the onion is baking. The Spanish, or any of the large varieties are specially good for this purpose, as they are mild flavored. There is apparently a given quantity of oil to a plant, and so the larger the bulb, the milder it is.

Always put onions into boiling water to cook. Plain boiled onions served with white sauce can be steamed, not boiled, and will then retain their shape and flavor much better. Always use very mild ones for this purpose.

Sets, the cheapest and easiest way for the amateur to raise onions. Plant five cents worth in March or April.

Do not peel them, but put them into boiling water, and boil for about an hour. Drain off the water, wipe the onions dry, wrap each one separately in buttered paper, put in an earthenware baking dish, and bake in a moderately hot oven for from two to three hours, accordng to the size of the onion. When fully cooked they will be a rich brown in color, and full of delicious, not at all pungent, juice.

There is one great universal objection to the use of the onion and all his family—the odor that it leaves on everything with which it comes in contact. It is like King Midas and the touch of gold, and just about as disagreeable:

> "You may break, you may shatter the dish if you will,
> But the scent of the onion will cling round it still"

Yet, if after peeling the onions, the hands are rubbed, on either a stick of celery, a slice of tomato, or a little fresh parsley, all sign and smell will disappear.

Imported wild onions from Italy, as sold in the New York stores. Very mild, and lacking in sweetness.

THE MUDDLE OF VARIETIES.

Have you ever tried to unravel the tangle of the host of varieties in this group? I did and in despair have given up the effort. Seemingly all the different types, or so-called varieties run into another, and vary in form to such a degree that after a few years what was originally introduced as a round onion becomes recognized as a flat one. This is true of the Danvers Yellow (yellow skin) and the Weathersfield, (red skin) both originally spherical. The original (round) Weathersfield, is now known as Large Red Globe. There are differences in the keeping qualities of certain types, however, and generally those of southern or warm climates are the poorest keepers, although the sweetest flavored.

THE BEST FOR STORING.

Leeks, the mildest and sweetest of all the onion group. No bulb is made, and they do not keep when out of the earth.

For long keeping, a tough skin is essential. This is found in such varieties as White Round Dutch, the Portugal (in either brown or white skin), and the popular White Globe. The Danvers is of the same type as the Portugal. The Tripoli onions are not such good keepers, but are valued as an early ripening strain, a character that is most marked, however, in the warmer sections of the country.

For delicacy of flavor, the Tripoli, Spanish, Yellow Trebons and Giant Rocca, are recommended. The well known Prizetaker, perhaps the most popular of all the domestic onions, is a form of the true

Spanish. The Bermuda type is a favorite because it is very sweet, mild, and very early. It is difficult, however, to get true seed of this type. One of the delights of onion varieties is that almost without exception any given variety has within it not only the capacity, but also the tendency to vary into a host of others. Moreover, as the soil and climate so greatly influence the behavior of the variety, one must experiment, and having found a type and a strain that suits the conditions, stick to that one (in any color that may please the fancy).

"LITTLE BROTHERS" OF THE ONION.

Associated with the true onion in our households are these four onion-flavored plants; garlic, shallot, leek, and chives. The use of them is distinctly restricted.

Garlic is too intensely pungent for the majority of people, and is usually used too liberally. A suspicion of its flavor adds pungency to a salad, but all that is necessary is to rub a cut "clove" around the bowl in which the dish is to be served. Good garlic can only be grown in a hot climate, and its cultivation should not be attempted in the North, where the true shallot will thrive much better, and having a similar flavor can be used in its place.

Shallots as used for flavoring; are also eaten as salad when young. Keeps well for a full year. The bulb is tinged with violet underneath the skin.

The *shallot* is remarkable in the family for its extremely delicate flavor. The habit of the plant is peculiar, the bulbs splitting into numerous "cloves," which in the young state are excellent in the same way as the "spring onions" already referred to. Indeed, people often confuse the two. The shallot rarely produces seed, and is in that respect much like the potato onion. It differs from garlic in its growth in this respect: the cloves of the shallot are distinct and separate, easily detached, whereas in the garlic the cloves are enclosed in an outer silvery gray skin. The true shallot is also silver gray, but a small yellowish or brown onion is often substituted for it. All these keep easily for twelve months.

MOST DELICIOUS OF ALL.

The *leek* is esteemed as a delicately flavored member of the family, but it does not keep at all. For home use in its season (which is late) I prefer it over all others of the tribe. The blanched leaf sheaths are eaten—and there is little or no bulbing at the root. Good leeks have white, thick stalks, fine-grained flesh, and part of the green top leaves as well as the stalks are eaten. They must be planted in very deep soil to make them grow as much white stem as possible, as the more of the firm white stem there is, the better the leek. Rich soil is required, the same as for onions. The seedlings are transplanted about the middle of June, planting deep enough to cover all but the centre leaves. As the plants grow, draw up the soil around them to blanch them. They may be had eighteen inches long. Though several varieties have been offered from time to time, there are only two types in the American trade. Large Flag is the most popular, but not the largest. Scotch Flag (or Musselburgh) makes a longer edible part, but it is not so thick.

A good model of onion for the housekeeper. The most convenient size is two inches in diameter. Red onions generally keep best.

Young "bunch" or "spring" onions used green and eaten raw, as salad. Shallots are also used thus. One way to use the thinnings.

Leeks are not eaten raw, but are used principally for flavoring soups, etc.; stewed and served with white sauce, they are a most dainty dish.

In *chives,* the slender green leaves are used chopped fine. It is essentially a salad plant. It is decorative, and hardy all winter. It is propagated by division, which should be done frequently, as otherwise the leaves will become coarse and tough.

GROWN FOR ITS HARDINESS.

The *Welsh onion,* rarely grown, is like a magnified chives and is used for seasoning. It does not form a true bulb. There are annual and perennial forms. Its only place is in the herb garden. It has the merit of great hardiness, and as such it is useful for a mild flavor in colder regions, just in the same way as the leek.—*Courtesy Doubleday, Page and Co., Copyrighted.*

HOW CAN I INCREASE THE FERTILITY OF MY SOIL?

A PRACTICAL ANSWER BY A SUCCESSFUL FARMER WHO HAS DONE IT.

This problem has been before me for a number of years, and it should arrest the minds of every farmer in Virginia to-day.

I will, in a brief manner, show you how I have brought some of my poor worn out lands to a high state of fertility. In the summer of 1902 I had a field of four acres in corn. This was cut down in the fall. I harvested two two-horse loads of stalk feed that shucked out a little less than two barrels, or ten bushels of corn.

In 1903 this field was sowed in cow peas and one ton of peavine hay was harvested.

The next summer, 1904, I seeded to peas again, applying 300 lbs. of acid phosphate per acre. This time I got 8000 lbs. of hay and a good portion was left on the ground, as they had fallen so badly that the mower could not get them.

In early spring, 1905, about ten tons per acre of manure was applied (broadcast). I broke the land with a two-horse plow as deep as they could draw it; right behind this came a two-horse Chattanooga subsoil plow, going fully eight inches below the other ferrow. This broke the land thoroughly about fourteen inches. I then planted to corn, using about 200 lbs. of guano per acre. The corn was left about eighteen inches apart in the step or row. From the four acres, I put in forty tons of ensilage as heavily eared as I ever saw in my life. Had six two-horse loads of stalk feed left that shucked out fifteen barrels of good corn. A great many persons went through this field of corn before it was harvested and all estimated that it would average between sixty-five and seventy bushels per acre.

In October I seeded the field to oats, timothy and clover, applying

1000 lbs. of lime (90 per cent. lime) per acre. Last summer I secured a fine crop of oats and in the fall I found the clover and grass so heavy that I thought best to mow it, and I got eight tons of nice hay. To-day I have a perfect stand of timothy. The ground is literally covered. When this land was first taken up and sowed in peas it was not worth hardly $5 per acre. To-day it is as good as any land on my farm of 500 acres and could not be gotten at $40 per acre. And four good paying crops have been gotten in the five years of improvement.

Another field I took up in 1903 was too poor to grow any vegetation of any kind; at least parts of it was, and it was badly washed to pieces.

In August this was gotten in a nice condition for seed, having been thoroughly broken with a two-horse plow before hand.

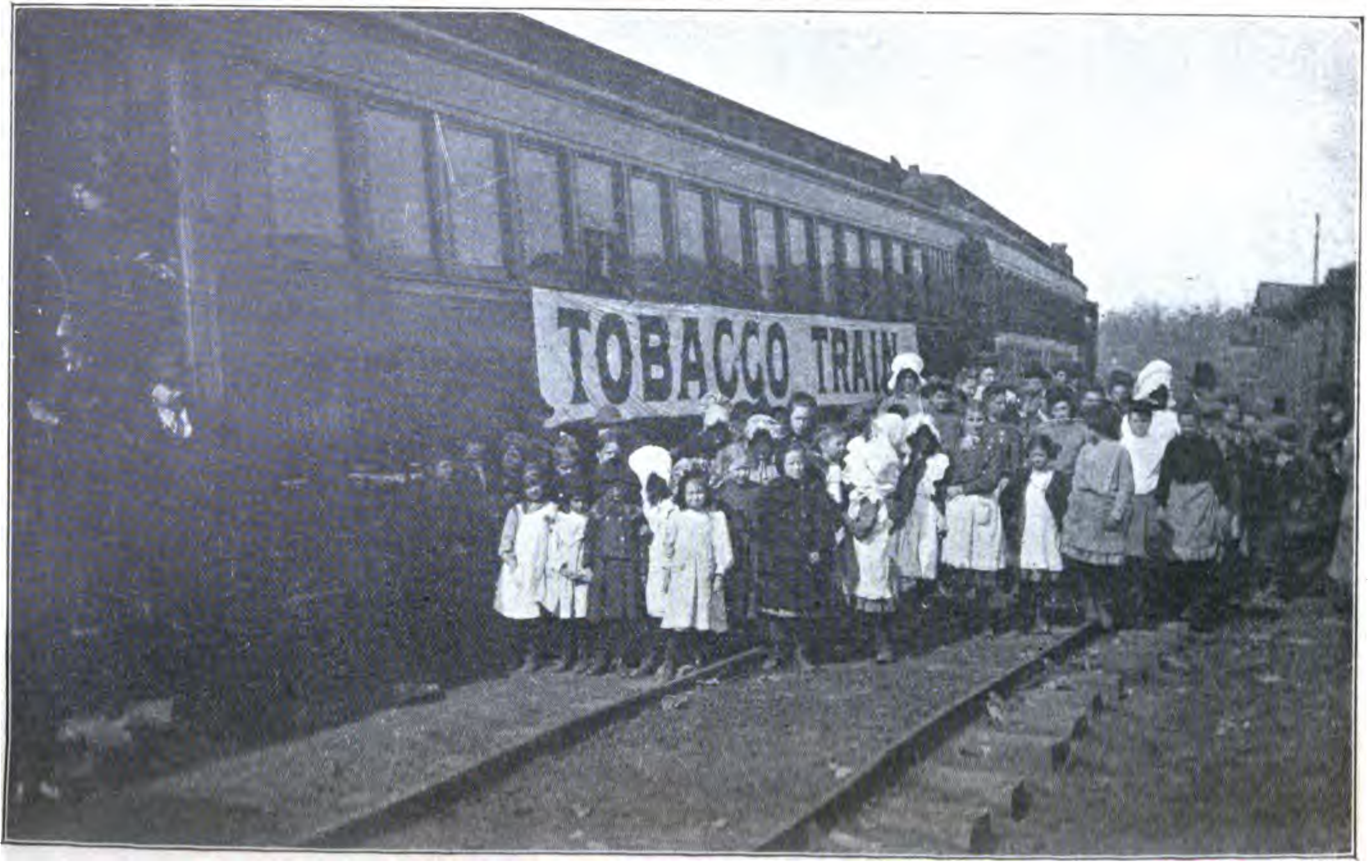
German clover was seeded, applying 400 lbs. of acid phosphate per acre. In November, when the clover had gotten good hold and well rooted, it was given a top dressing of manure. The spring following, in 1904, I found that I had a heavy crop of hay. This, however, bedded so badly that I did not get more than half of it with the mower.

About June 1st what vines that were left were turned under with a two-horse plow, followed by a two-horse subsoil plow, both together breaking the ground thoroughly from 12 inches to 14 inches deep.

I then seeded to peas, applying 400 lbs. of acid phosphate per acre. In the fall I had the heaviest crop of vines I ever saw in all my life. These bedded and were so badly tangled that only fifty per cent. of them were gotten with the mower. The next spring, 1905, this field was planted to corn, applying 150 lbs. of guano per acre. This was the best corn on my farm. A portion of it was cut for ensilage and was never measured. Several of my neighbors and friends went through this field of corn before harvest time and they all agree with the writer that it would average seventy bushels per acre. My experience is, that the subsoil plow, peas, lime and farm manure, together with thorough cultivation, all applied in a practical manner, will not only improve our lands, but we will get a neat profit along with it.

I have my lands divided into four (4) shifts: First year, oats or wheat; second year, grass; third year, peas, or remains in grass; fourth year, corn. Thus the same field is planted in corn every four years.

I find that when corn follows peas, (especially if the land is subsoiled) the corn always keeps a nice green color, and I have never yet failed to get a good crop, besides I am not troubled with grass and the land keeps mellow and soft through the summer and very little cultivation is required.



TOBACCO INSTITUTE TRAIN.

The train is crowded inside with tobacco growers, but the school children hear the lectures through the windows.

I use the subsoil plow in fall or spring before the field is planted to corn. The lime is applied when seeded to grain.

I am peculiarly interested in the subject of agriculture as well as breed pure blood stock, and I am always glad to talk with any one on the subject.

Respectfully,

W. B. GATES.

"Evergreen Farms," Rice Depot, Va.

PASTURING WHEAT.

The pasturing of wheat is an old practice about which opinions of practical men differ widely. The subject has been studied during several seasons by the Oklahoma Station in the following way with the results stated:

"A suitable location was selected in a farmer's wheat field where pasturing the wheat is followed, and nine half-acre plats were laid out and separated from each other and the field by 3-foot alleys in which the wheat was hoed out. Six of these plats were fenced separately and provided with gates, so that the stock might be allowed to run into any certain plat or kept off. Three plats were not fenced, which allowed the stock to pasture on them just as they pastured the general field. * * * The following treatments were given: The gates on two of the plats were left open all the time during the fall and winter and the stock allowed to run on these plats whenever they were in the field, but the gates were closed March 1st, and no stock allowed on these plats after this date. * * * Two other plats were handled the same as the above two plats up to March 1st, but from this time on, the treatment differed. After the stock were taken off, these two plats were not pastured until April 14th, on which date eight cattle and three calves were turned on the two plats and kept there for three days, except at night. * * * On the other two plats that were fenced, the gates were kept closed all the time and no stock allowed on the plats. * * *

"Horses and cattle were turned into the field in which these plats were situated, on October 24th, at which time the wheat furnished considerable feed. Up to about the middle of January, the pasturing was very fair. About this time the weather turned cold and snow fell, and during the greater part of February the weather was very cold and the ground covered with snow almost all of the time. During the greater part of these two months little wheat pasturing was available and the amount given the field for the season was lighter than usual. The latter part of February the weather moderated and the snow went off and by March 1st the wheat was making a nice start to grow. On this date, March 1st, the gates on the "fall and winter" pastured plats were closed and no stock allowed on the plats again. At this time the ground was a little soft on top, but not in a condition to allow the stock to damage the wheat materially by tramping. At this time there was some difference in the appearance of the pastured and the not pastured plats, the former being covered with considerable more growth. Heavy rains fell March 11th and showers on the 18th. On April 13th but little difference could be seen in the growth on the "fall and winter pastured" plats and the "not pastured" plats and the wheat in the field. In all these cases the growth was very good. It is well to bear in mind here that the pasturing given the field was lighter than usual, and at no time was the wheat damaged by tramping, and, aside from the rust that attacked the wheat, the conditions for growth were very favorable throughout the season. * * * From the three years' trials the indications are that where wheat is judiciously pastured in the fall and winter and the stock removed in the spring, by March 1st, the yield of grain will be little if any reduced by pasturing and in some cases it seemed to increase the yield of grain. The results of the three years show without variation that the yield of grain is greatly reduced, usually *about one-half, by late spring pasturing of wheat."—Oklahoma Report.*

THE POSSIBILITIES OF HAY RAISING IN SOUTHSIDE VIRGINIA.

The farmers in Southside Virginia, especially in the tobacco belt, have always been under the impression that hay could not be raised to any amount on our lands. I will give my experience last year of a crop raised on twelve acres of land. This field seven years ago was as thin as any land in Southside Virginia. I will give an idea of how it was cultivated. It was plowed, seeded to peas, followed that fall by winter oats and wheat; followed next summer and seeded to grass. It was cut two seasons. The fifth year it was plowed for corn, with one ton of lime to the acre. Corn was taken off and winter oats and wheat seeded that fall. The field was plowed next summer as early as the wheat and oats could be gotten out of the way. The land was harrowed each week until the 1st of August. I then seeded the field to

Hay field in Southside Virginia; yield 4½ tons of hay per acre.

grass—four parts timothy, four parts herds grass and one part clover—using twenty-five quarts of seed to the acre. Hoping to inoculate the soil with alfalfa, I mixed in one bushel of alfalfa seed, which was mixed in with all the seed. The land was well prepared and the seed drilled in with 400 lbs. of raw bone to the acre. It was crossed drilled, half of seed, half of fertilizer being used each way. A heavy roller was used each way, leaving the land in fine shape. The seed caught well. By last of October I had a nice mat of grass on the land. I top dressed this field during winter with four tons of manure to the acre, with a manure spreader. I commenced to cut this field about July 9th; seventy loads of well dried hay was put in the barn. I weighed one load, weighing 1500 lbs., making fifty-two tons of hay. The alfalfa in first cutting was almost as high as the timothy and other grasses. The second crop I cut one ton and a half to the acre—two-thirds of which was alfalfa. The field at this writing, January 1st, is well soded and bids fair to make equally as good crop as last year. I see no reason why this country cannot be made to produce as much hay as any part of Virginia. Hay is selling at my station for twenty-five dollars per ton. With five tons to the acre, our country ought to bloom and blossom as never before. We can do it if proper effort and intelligence be put forth. Our section must find more cattle for beef or milk to give us the manure to help bring up our lands.—*T. O. Sandy.*

AS TRUE AS GOSPEL.

When the farmer grows any of the legumes, either red or crimson clover, cow peas, veitch, soy beans or any of the legumes, he is doing two things that will always improve his soil. He is getting nitrogen in the cheapest way possible for him to get it—at the rate of from $5 to $20 per acre, according to the yield of the crop. He is putting in his soil vegetable matter to decay there, which must always be in the soil before heavy crops can be grown. This decayed vegetable matter is called by a short name, *humus*. This humus makes the land soft and friable; it prevents it from breaking up cloddy or forming a crust on the surface. This humus increases the capacity of the soil to hold moisture. The yield of the soil is largely in the power it has to hold moisture; all of our crops are drinkers, not eaters. The humic acid produced by the humus also gradually dissolves the insoluble potash and phosphoric acid that is found in sufficient quantity in all soils, and makes it soluble and ready to feed the crops. These are most important facts, and worthy of careful consideration, and will, if practiced year by year, reduce the use of commercial fertilizers, improve the soil and increase the profits in farming.

EARTH ROADS.

Acts of Assembly approved March 6, 1906, provide State aid in the form of convict labor for the permanent improvement of public roads. This means the improvement of highways, by giving them surfaces of stone, gravel or some material other than earth, which remain hard and permit unimpeded travel at all seasons of the year.

As it will be many years before we can hope to have even the more important roads of the State improved in this manner, it is apparent, that in our efforts to better the condition of our highways, we should seek to learn and apply the best practical methods for improving and maintaining earth roads.

Unfortunately many of our early roads were opened with little regard to grade and drainage; frequently they were made simply by widening old trails located through the country by animals or man, with no thought for the needs of wheeled traffic; and frequently roads were laid out to follow boundary lines between adjoining tracts of land with more regard to the wishes of the abutting land owners than for the good of the general public. Often, too, roads are found running with steep grades over hills, when with comparatively short increases in length they might go round them. It has been suggested as a probable explanation of this latter fault, that our pioneer road-builder's only tool was an axe, which necessitated his opening a road over ground, the surface of which did not slope across the road. He, therefore, could not take advantage of the easier grades to be obtained by digging the road around the hill-side.

Whatever may have been the original causes of so much bad location, the fact remains that very many of our roads can be greatly improved by relocation, which would give easier grades and better drainage.

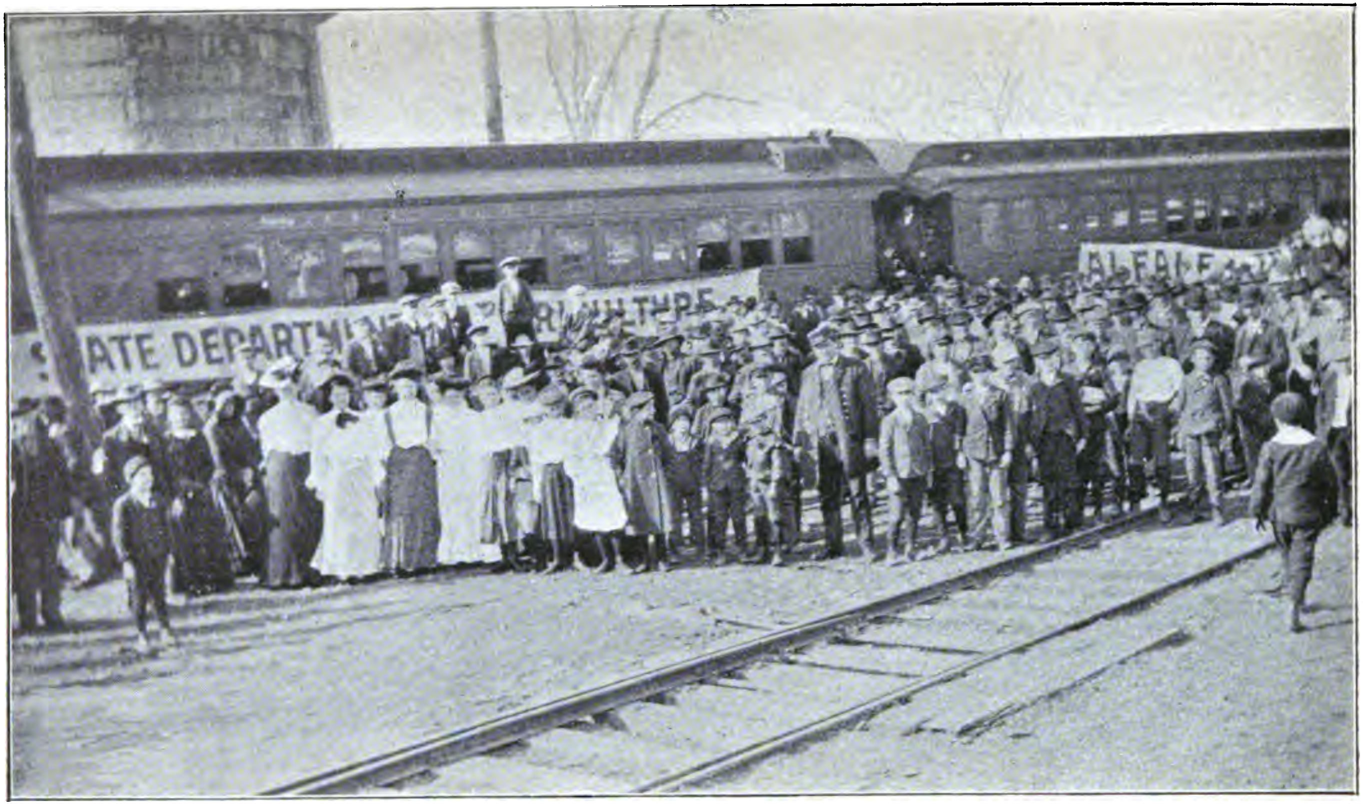
One of the chief difficulties encountered when a change of location is proposed comes from the opposition of land owners along the line of the road. Their objections and demands are often unreasonable, and they stand out against changes that would not only benefit their neighbors, but which most probably would add to the value of their own property. It is hoped that the rapidly growing sentiment in favor of better roads will lead to a more liberal policy in such matters and arouse a spirit of emulation among property holders in their individual efforts and contributions towards securing for their communities the blessings of good roads.

When it has been decided to relocate one or more sections of a road, the services of a competent engineer should be secured and the work done under his supervision. The proper location of a road is a matter of prime importance, and should not be undertaken without expert advice. All work on an earth road should be done in such a manner that when the time comes for its permanent improvement, the cost of same will be materially reduced.

It has been well said that water is the greatest enemy to good roads, and to minimize the damage done by rain and snow must be the chief aim of the road-worker. This, of course, means drainage well planned and constantly maintained. Drainage from the surface of the road to the sides, and then from the sides of the road to prevent the water soaking into the bed.

To be properly drained the surface of the road should be given a slope from the centre to the side ditches of about one inch to the foot, and the space between the edges of the roadway and the ditches kept as clear as possible of all vegetable growth. Side ditches should be dug of sufficient capacity to carry off quickly the rain or snow water from the road, and should never be given a grade of less than six inches to the one hundred feet, and when as near level as that, they should be kept very clear, otherwise the water will not run off rapidly enough. All ditches should lead to the nearest water course or natural drain where the water will be carried away from the road, and the ditches relieved as frequently as possible.

In low, wet or springy land and in certain kinds of clay it is not only necessary to drain the surface, but it is equally as important that the substructure be kept dry, otherwise the water that comes up out of the ground will have the same softening effect as that which falls from above. Roads located in such places will be greatly benefitted by underdrainage. These drains are not expensive and are easily made. A line of porous farm tile, laid at a depth of about four feet below one or both sides of the road, with a continuous fall to an outlet, is the best and most usual method. Where tile cannot be procured, any of the usual methods used by farmers for building "blind ditches" may be substituted. Care should be taken to grade the ditches to a true grade, and the backfilling should be with stone or pervious earth. The deep ditches dug outside of many of the earth and shell roads in Eastern Virginia, where



ALFALFA INSTITUTE TRAIN.
After the Farmers' Institute lecture in the Shenandoah Valley.

the ground is very flat, are of material benefit to those roads. In low ground, if sub-drainage is impracticable, the road should be built up two feet or more above the surrounding surface.

Where it is necessary to carry the ditch-water from one side of the road to the other, it should always be done by a ditch under the road and not by a cross-ditch in the road. These cross-ditches should be of terra-cotta pipe or stone, and should be of a sufficient depth below the surface of the road to have at least one foot of earth on top, and in case of terra-cotta pipe over 12 inches in diameter, the covering of earth should be not less than the diameter of the pipe. Either of these drains is more efficient and economical than a wooden box, although the first cost is somewhat greater. No size smaller than 12 inch pipe should be used for this purpose, unless it is impossible to get the depth sufficient for a pipe of this size. Small size pipes choke very easily and are hard to clean out.

When a road is cut along the side of a hill, the slope on the upper side should be protected from the washing of heavy rains by running a catch drain or intercepting ditch in the hill-side above and two or three feet back from the top of the slope; this ditch being carried to a main-drainage outlet. Slopes in cuts should be at an angle that will prevent washing or sloughing into the ditches. This varies according to the material, from one vertical to one horizontal in clay, to one vertical to two horizontal in sand. The slopes of all embankments should be not less than one vertical to one and one-half horizontal.

The importance of good drainage cannot be too strongly emphasized, for it can be put down as a fundamental principle, that no good road can be maintained without proper drainage. Within recent years millions of dollars have been spent on the maintenance of roads in Virginia, which, very largely from lack of proper drainage, has been practically thrown away.

Notwithstanding the fact that so much has been said and written on the absolute necessity of proper drainage to obtain the best results in the maintenance of roads, recent visits to many of the counties of this State have convinced the writer that the subject has not been given the attention it should have received. In some cases where ditches have been dug, drainage has not been secured, owing to the road not being properly crowned or sloped so as to enable the water to escape into the ditches from the surface of the road.

A practice to be avoided in cleaning out ditches is that of throwing back into the roadway the accumulation found in the ditches, which is composed largely of wornout material, leaves and debris of a nature that will not compact in the road. This material should be thrown clear where it cannot get back into the road or ditches.

Where additional material is needed for raising the centre of the road, care should be taken to secure earth free from sod, roots, weeds or vegetable matter of any kind. The road grader, which is indispensable for the economical working of earth roads and which accomplishes excellent results where intelligently handled, is too often used without first clearing way the vegetable growth from the sides of the road, which is consequently scraped up and forms a soft, spongy mass in the centre of the road.

In general all material used for repairing roads should be of the same character as that of which the road is constructed. Wherever in repairing the roadbed is softened by ploughing, harrowing or scraping, or by the addition of new material, it should be compacted by a roller, otherwise it will be cut to pieces by traffic, and much of the advantage of the crowning of the roadbed lost.

A method of working earth roads, which has gained considerable favor in a number of States, particularly in the Middle West, and which has the strong endorsement of the Highway Department of many States, is the use of the road-drag, which, it is said, accomplishes, though in a much more gradual way, the work of the scraper and roller in crowning and compacting the surface of earth roads. A recently issued pamphlet on the construction and use of the drag may be had by application to the office of the State Highway Commission, at Richmond.

By the addition of sand or gravel to a clay road, or clay to a sand road in proper proportions, a comparatively hard and durable surface is secured. It is not possible to give an exact rule for estimating the amount of sand to be used on a clay road, or *vice versa.* In order to get the best results, Prof. Baker, a leading authority on roads, says: "Sand may be worked in with a harrow or cultivator and then rolled. Cinders may be used in a similar manner; but pebbles, the largest of which are about the size of a pea, are best for this purpose. They should be laid on in a two-inch layer and then rolled, the roadway being previously sprinkled if it is not already soft. After applying and rolling in a layer of pebbles, the road should be opened to traffic for a month or two, after which another layer should be added. Three or four layers will make a road fairly good except during a long-continued wet time."

Many methods which will be of great benefit for certain local conditions will suggest themselves to the intelligent and observant Road Superintendent who keeps in touch with the general methods used by the most successful road engineers. This can only be done by reading and discussion, and by occasional visits to places where work is being done. In road work, as in all other matters, our ideas are broadened and our usefulness increased by intercourse with our fellowman.—*P. S. J. Wilson, State Highway Commissioner.*

DODDERS INFESTING CLOVER AND ALFALFA.

About twenty-five species of dodder have been found in the United States. They are all annual plants with yellow, orange, white, or pink thread-like stems, small yellow, pink, or white flowers, usually borne in clusters, and minute scales in place of leaves. All are parasitic on green herbs or shrubs, about which their stems twine, drawing nourishment through minute rootlets or suckers which penetrate the bark of the host plant. Some are confined to particular kinds of host plants. Some grow only on plants of the clover family, others only on shrubs like the low willows, while a few appear to thrive on almost any kind of green vegetation. The majority of the species, and especially those east of the Rocky Mountains, are found on the dense vegetation in rich bottom lands, where they do little harm; but a few growing on clover, alfalfa. and flax cause serious injury to these crops.

RANGE OF DIFFERENT INJURIOUS SPECIES.

Alfalfa dodder, *Cuscuta epithymum,* is a European species which has been introduced into the alfalfa fields of the Pacific Coast and Rocky Mountain region, but is rarely found east of the Missouri River. It thrives best on alfalfa or clover, and in many localities it is very destructive to these crops. It can live, however, or many other kinds of plants.

Flax dodder, *Cuscuta epilinum,* is an introduced species most commonly found on flax in Europe. It is the most prevalent species of dodder on alfalfa in Wyoming and Idaho, and is occasionally found in the States farther east, especially in localities where flax has been cultivated.

Clover dodder, *Cuscuta racemosa chiliana,* is an introduced species infesting clover fields in the Mississippi Valley. It lives only on the clovers and closely related species.

Warty dodder, *Cuscuta indecora,* is a native species sometimes found on clover and alfalfa in the Southern States and in the prairie regions. It grows also on a great variety of other plants.

Field dodder, *Cuscuta arvensis,* is the most injurious native species east of the Mississippi Valley, and is found in less abundance in nearly all parts of the country farther west. It grows usually in dry upland meadows and pastures and lives upon a great variety of host plants. A single plant of field dodder has been found with its thread-like stems drawing nourishment from red clover, rabbit's-foot clover, flat-stemmed meadow grass, heath-leaved aster, ox-eye daisy, chondrilla, shepherd's purse, and wild onion. It will apparently grow on almost any herbaceous upland plant, but it thrives best on the clovers.

These species can be distinguished from each other only by technical characters that are practically indiscernible to the naked eye.

PROPAGATION AND MANNER OF GROWTH.

Aside from the fact that some of these species are confined to certain host plants while others are not, the habits of all are similar. The seeds are generally introduced with impure clover or alfalfa seed, or distributed with hay. They are blown about over the snow or bare ground in winter with pieces of the dead clover and alfalfa stems, but their distribution is effected chiefly by artificial means.

Dodder seeds placed in the soil germinate, under favorable conditions, in practically the same manner as do the seeds of clover or other plants, but instead of two green leaves there appears above the surface a very slender, inconspicuous yellow shoot. This bends to one side, then swings slowly around, lengthening meanwhile, until it strikes a green plant. If no plant upon which it can live is within reach, the dodder seedling dies as soon as it has exhausted the nutriment stored up in the seed. But if the swinging shoot comes against a congenial host it twines about it, in some places tightly, in others loosely. Where it binds the host plant tightly many rootlets or suckers (haustoria) are produced, which grow into the tissues of the host plant and draw therefrom the elaborated sap in much the same manner as rootlets of common green-leaved plants draw crude nutriment from the soil. The host plant, robbed of a portion of its richest sap, becomes dwarfed, and many plants, especially clovers, are actually killed. The dodder plant, however, continues to grow. The lower part of the dodder stem dies and withers as soon as the nutriment in the seed is exhausted, or as soon as the shoot is made fast to a host plant.

METHOD OF SPREAD IN FIELD.

As soon as the upper part becomes well established on a living host plant, branches are produced, waving slowly about, like the first shoot, until they reach some green plant upon which they can grow. By the time the host plant first attacked dies, these branches are firmly established on several new hosts. Thus the dodder lives on, dying behind as its support is destroyed and pushing out branches in all directions to attack new plants. In this manner the growth from a single dodder seed may spread over several plants of clover or alfalfa. If this were all, the host plants might in some cases recover and produce a second crop from the roots. But soon after the dodder becomes established on the host plant it begins to produce clusters of flowers, and, if not interrupted, a succession of flowers and seeds is produced by the advancing vines until all are killed by frost.

THE SEED.

The seeds, thus gradually ripened and dropped, retain their germinative power five years or longer under favorable conditions, but in warm, moist soil some of the earlier of them will usually germinate during the same season in which they are produced. The conditions most favorable for their germination are the same as those which induce the clover roots to send up new shoots. As soon as the tender clover shoots begin to grow they are attacked by the dodder seedlings and their destruction is completed. If the dodder plants remain undisturbed, a supply of seed is left to be scattered by the winter winds; but if they are mowed and raked up with the crop some of the seeds are sure to gain a much wider distribution, while enough will be shaken out to reseed the original locality the following year. If threshed with clover or alfalfa, many will certainly leave the separator with the other seeds, from which they can be removed only by the most careful recleaning. *It is never safe to sow clover or alfalfa seed from a dodder-infested field.*

METHODS OF ERADICATION.

When small dodder-infested spots are discovered in alfalfa or clover, steps should be taken immediately to prevent the further spread of the plant. Its eradication becomes exceedingly difficult if allowed to remain until seeds are produced.

ON SMALL AREAS.

Mowing—All of the vegetation on the infested spots and for a distance of at least a yard beyond where the yellow vines are observed should

After the Instittue, Henry County tobacco growers.

be mowed as closely as possible with the scythe. If the dodder seeds are formed, the material may be fed to stock, or it may be raked to the center of the area after being allowed to dry somewhat and then saturated with kerosene and burned. In any case it should be destroyed to prevent the possible ripening and distribution of dodder seeds or propagation by means of the dodder vine, and it is best to remove it from the field. Too great care cannot be exercised in this apparently simple operation to prevent the distribution of dodder seeds or pieces of vine. If the air is moist, pieces of the dodder vine falling on fresh clover or alfalfa plants are likely to start new centers of growth. There is less danger of this on a hot, dry day, when the dodder vines lose their vitality more quickly. About a week after the infested spots are moved they should be examined for a new growth of the dodder vines. The center of the spot where the seedling dodder started is most likely to show new growth, since the coils from the seedlings are lower down on the clover than those of the later growth, and some of them are likely to remain in the stubble. If there are only a few of these coils on the stubble they may be removed by hand; but if numerous they may best be treated by other means.

Application of chemicals—Strong brine, sulphate of lime, and dilute sulphuric acid have each been used with more or less success in destroying dodder. The sulphates of iron, potassium, and copper are most effective when dissolved in water and liberally applied in ten per cent. solutions. The solutions used for this purpose should be stronger than those ordinarily used in combating insects or fungi, as in those cases only the insect or the parasitic plant is to be destroyed with as little injury as possible to the host, while in this case both host and parasite are to be killed to the ground. Ten per cent. solutions may be safely used in the best kinds of spraying apparatus, their working parts being noncorrosive. If only a few small patches are to be treated, or if no spraying outfit is at hand, the liquid may be applied by dashing it on the infested spots with a pail or dipper. Wooden utensils would be acted upon less than tin or iron. Care must be exercised lest the solutions come into contact with the clothing or person. These solutions have sometimes produced successful results when applied directly to the plants when first discovered, but they are generally more effective when used thoroughly to drench the stubble after the plants have been mowed and removed as described above. The solution, to be effective, must come in contact with the dodder vine, and especially with all of the tight sucker-bearing coils. It also kills the clover or alfalfa to the ground, but these plants usually grow up again from the roots. The places should be watched for dodder plants that may come from seeds.

Hoeing infested spots—One of the most practical methods to complete the eradication of dodder after removing the vegetation from infested spots it to spade or hoe the soil to the depth of about two inches and to keep this stirred so as to prevent the growth of any plants for three weeks. This method is especially recommended if the dodder vines had begun to produce seed before their removal. The shallow cultivation will induce the germination and consequent destruction of the dodder seeds. Shallow cultivation is best, since if the soil is turned over spade deep, the seeds will be buried at different depths. Those buried deeply cannot send shoots to the surface, but they may retain their vitality several years so as to be ready to grow when turned up by the plow.

Burning—Fire may be used to destroy the dodder. To destroy by this means seeds that have fallen to the ground, requires a considerable degree of heat maintained for several minutes. This is secured by covering the infested area with light wood or chips well sprinkled with kerosene. Straw or shavings do not produce heat enough close to the ground.

Covering infested spots—Dodder has been killed in some instances by smothering it with a thick covering of manure, muck, or ashes, but these methods cannot be recommended. A thick sprinkling of wood ashes when the clover is wet with dew may accomplish the desired result chiefly through the action of potash, but this method also is unreliable.

All of the methods given above are for application in fields where the dodder is confined to comparatively small spots. They are not practicable where large areas or considerable portions of a field are infested.

FOR ENTIRE FIELDS.

Grazing—One of the best methods for subduing dodder after it has become widely distributed, is to turn sheep on the land, confining them with a portable fence if necessary, so that they will keep the infested areas closely grazed. While pastured in dodder-infested fields the sheep should not be moved about the farm any more than is necessary, as they are likely to carry dodder seeds and pieces of the vine in the clefts of their hoofs and in their wool.

Cultivation—Dodder can usually be eradicated by thorough cultivation with corn or root crops for two successive seasons. For the destruction of alfalfa dodder and clover dodder, any crops may be cultivated except those of leguminous plants; but, as warty dodder and field dodder grow and thrive almost equally well on a great variety of host plants, only such crops can be grown for their eradication as will admit of clean cultivation.—*U. S. Circular, No.* 14.

The old and young enjoy the Institute lectures on the railway train; the first held in the South.

THE FARMER AS A BUSINESS MAN.

At a meeting of fruit growers not long ago, when the persons present were discussing the matter of forming an organization to market their fruit crops, there was a difference of opinion as to whether such a plan was practicable. Finally, a very substantial farmer arose and said:

"Mr. Chairman, I want to ask a question: Who is it that fixes the price of any commodity, the buyer or the seller?"

And then the suggestion was made that the seller fixes the price, except in the case of the farmer—and he takes what the buyer offers to pay. Isn't this about true? A certain New York financial paper, in discussing the movement among farmers to control the products of their farms, so that they can have at least a voice in fixing their value, says: "Proverbially, the American farmer has been a poor merchant. He has taken what the trade was willing to give him, and always regarded himself as subject to the openest kind of competition as a seller."

This statement is not overdrawn, but now the tendency is for farmers to study carefully all the details of their business—to study the selling of their crops as well as how to produce them most economically. The tobacco and fruit farmers ought to be among the leaders in this movement. The cotton growers of the South have already improved their condition, and in many localities the fruit growers have also made a start. But the present season has demonstrated that there is need for further improvement along this line, and it is to be hoped that during the coming winter the fruit growers and tobacco farmers in every section will get together and perfect their organizations.

This new movement does not mean to form a trust, which shall fix a price at which products shall be sold—rather it looks to an improved system of marketing, which shall save much of the useless expense of the present system. It is a movement to co-operate, rather than to combine.

MONEY IN TURKEYS.

The following picture represents a flock of turkeys raised by one hen in Albemarle county, the property of Mrs. Chas. A. Miller. It is unfortunate that a definite valuation cannot be placed on this flock, as some were sold at 18 cents a pound, dressed, others at 12½ cents, gross, and a portion kept for breeding purposes. However $50 would appear to be

Thirty-two turkeys—the products from one hen, summer of 1906. Sold for $60.

a reasonable estimate; but the writer would have no difficulty in convincing persons familiar with the possibilities of good feeding, that 32 turkeys could easily be marketed at $60. There was nothing unusual about the care given the flock, or in the breed. As a result of the death of one of the hens two days after hatching, forty young ones were given one hen and placed in a square stick coop covered with boards; the little ones were allowed to go in and out and the hen was confined about ten days. At the end of this time the mother was given a short range a portion of the day. They were fed corn bread and cottage cheese five times a day. After this, the hen was given a longer range, but particular pains were taken to feed them regularly three times a day, calling them up for noon meal, which served the double purpose of necessary feeding and holding them close to the house, thus preventing long ranging, which in many ways depletes a flock when small. After six weeks very little attention was paid them except to call them up for noon meal; but it always pays to give turkeys all they will eat (before they go to roost) until they are ready for the market. As nothing was done unusual, either in the feeding or management of the flock, and as the season was very wet and as unfavorable as could well be, many loosing all, suggested to the writer that some underlying reason for the hardiness of the flock might be found. Two moth balls were placed under each hen while setting, which may have injured the hatch, but the presumption is by this means the hen and little ones were absolutely freed from vermine. It was noticed that not a little one died from any disease whatever, the eight that were lost were either drowned or caught by hawks, and the further fact of the same hen losing all the year previous by the time they were two weeks old and no moth balls were put in the nests, suggests that possibly here may be some virtue in their use.

The experiment will be continued this year. Without inviting any discussion on the subject, the end sought to be attained cannot be questioned, viz., to rid a flock from vermine is absolutely necessary in order to be successful, and to do this, the hen is the proper place to begin the work of extermination, or else the flock will be exterminated.—*M.*

MARKETING FARM PRODUCE.

To anyone who will take the trouble to make even a cursory examination of the markets of any of our large cities it will be evident that there is ample room for improvement in the manner of marketing farm produce. A very little additional inquiry into the subject will reveal a condition of things which, involving as it does a waste of material and labor on the part of the producer aggregating an enormous loss, may be described without exaggeration as disastrous. It has been asserted with much truth that the success of the average farmer depends upon an aggregate of small profits, and it may be stated with equal truth that failure is often, if not usually, due to an aggregate of small losses.

The waste in American households has become proverbial, and it is popularly believed, and with good grounds, that the waste of an average American household would support an average French or German family. This loss, however, falls upon the consumer, whether farmer or townsman, whereas that which it is the purpose of this bulletin to discuss, namely, the loss due to ignorance or carelessness in marketing farm products, falls upon the producer.

Genius has been described by some great writer as "the art of taking infinite pains." Whether this be so or not, it cannot be denied that in marketing farm products the art of taking infinite pains is essential to profit, and the lack of it insures certain loss. Of this anyone who will take a short walk through the markets or market streets of our cities or visit the wharves or depots where farm products are extensively handled can speedily convince himself. On every side he will see farm produce of a good quality selling at reduced prices, owing to the form or manner in which it is put up, and, in not a few cases, cast aside by the dealers as not worth handling, owing to a damaged condition, which with a little care would have been avoided. In such cases the only profit accrues to the transportation companies, whose charges for carrying freight of course depend not upon quality but quantity. The aggregate sum yearly paid to railroads and steamships for carrying farm products which on arrival prove to be unsalable no one can estimate, but it must foot up enormously, to say nothing of the freight charges paid on goods sold far below market rates because put up carelessly or in unsuitable or unpopular packages.

GENERAL RULES.

While each of the various products of the farm and garden has to a greater or less extent its own particular characteristics, and requires a more or less different treatment, there are some general rules which apply equally to every kind of produce and to every market and which are of the utmost importance. The cardinal virtues in preparing all kinds of produce for market are neatness, cleanliness, and uniformity. The fact that the goods packed are to be eaten should never be lost sight of, nor should it be forgotten that if they are to bring the very highest prices they must be sold to people whose appetites are not easily tempted, but who have the money to pay for practically everything they crave and who will and do pay well for the extra attractiveness which tempts them. With these facts in view the great importance of neatness and cleanliness is easily apparent. Nor is it safe ever to aim at any but the highest prices for good produce, for should a shipment deficient in any way as to style, form, neatness, etc., happen to reach the market at a time when either the demand is light or the supply excessive, it will remain unnoticed until the "strictly fancy" goods have been picked up by the buyers, and then, the demand having been supplied, must await the next day's buyers, suffering severely by the delay and eventually being either sold to peddlers for perhaps less than the freight charges or hauled to the "dump," a total loss.

The following is a sample of an everyday occurrence: Two fine lots of radishes will come to market, both lots of the finest quality. One lot will be made up into bunches, in each of which the radishes will be of equal size and the bunch neatly tied. In the other the bunches will contain radishes of various sizes and the bunches be clumsily tied. The first buyer that comes along will snap up the first lot at a "fancy" price, while the second lot will be neglected until the demand is exhausted, and will ultimately sell for little or nothing. The same difference may be seen in several lots of carrots, careful washing proving an important factor with this and other roots. Neatness and attractiveness invariably pay well for the trouble expended.

Undoubtedly cleanliness is included to a considerable extent under the heading of neatness, but so important is it that it is deemed worthy of separate consideration. It is found lacking more often probably in the preparation of fruit than of other produce. Too often juice-stained cases injure the sale of really choice berries, or the dirty finger marks of the pickers on the boxes will turn the buyer away. It is needless to say that the presence of sticks, leaves or other rubbish invariably injures the sale. Even potatoes have sold more readily because marketed in clean, well-filled sacks.

Uniformity is of the greatest importance and requires a little more effort. Some varieties of produce are invariably marketed in uniform packages, the 30-dozen egg case, for instance, being the universal standard, but others, particularly fruits and vegetables, are put up in various packages, and while some pertinent suggestions may be made, the only safe rule to follow is to ascertain the requirements of the market or markets to which you expect to ship, and be guided by them. It may, however, be accepted as a practically unvarying truth that the finest produce will not bring the highest prices if packed in unusual packages. The writer saw an instance of this recently:

A Texas concern, new in the business, sent its fine crop of Gem melons to market in boxes containing 1½ bushels, the usual package in this market being a half-bushel basket. The commission merchant who received the consignment, although recognized as a leader in Gems, tried in vain to secure a higher price for the more generous boxes, but was finally obliged to sell them at the then market price for half bushels, viz, $1.25. Fortunately the producer was present when the shipment arrived and immediately telegraphed his associates to ship Gems thereafter in nothing but half-bushel baskets. As a consequence, the last shipment from that source, consisting of 500 bushels in 1,000 half-bushel baskets, sold for exactly the same amount as each of the two previous shipments, which aggregated 1,500 bushels each. Needless to say, that shipper will study the peculiarites of his market before making further shipments.

The above may seem like an exaggeration, but it was an actual occurrence, and the principle may be verified any day. The explanation is simple: The retailer becomes used to a certain sized package and knows immediately of how many divisions it is susceptible, if it is to be divided at all, and so can easily find its selling price and estimate his profit. New packages require new calculations, which the retailer has little time to make, and which he will not undertake unless obliged to. In the instances of the Gems referred to, they would meet with ready sale in half-bushel baskets, not only the size of the package but its convenience, the baskets being provided with bails or handles, particularly adapting them to the retail trade. The 1½ bushel boxes were too large for retail consumption and the packages too clumsy to be conveniently handled. Their purchase necessitated the retailer's providing additional baskets and making the necessary subdivisions, for all of which he could ill afford the time and for which the producer paid handsomely.

Honesty should constitute the next general principle to be observed. The mere mention of it may appear out of place in a paper of this nature, but it is not from a moral but from a money-making standpoint that it is here considered. There is probably no business to which the adage "Honesty is the best policy" so aptly applies, and it seems as though there were no legitimate business in which it is so often disregarded. We believe it can be safely said that in every instance when petty deception is attempted it proves a boomerang. Probably the dishonesty most commonly practiced is improperly " facing " packages, such as barrels of potatoes, apples, and other fruits, baskets of peaches, and particularly boxes of berries. The trick has been tried so often that everyone, even the most inexperienced buyer, looks out for it. Before buying a case of berries every buyer will take out several boxes and one after another upset them into his hand. This, of course, exposes practically all the berries in the box, and if any deception has been attempted he is apt to lose faith in the entire shipment. With baskets, such as peaches, plums, etc., are shipped in, several slits are cut in the sides, thus exposing the contents from top to bottom. Sharp hatchets are used to remove pieces from the sides of barrels, etc. But not only is immediate discovery almost inevitable, but even when the shipper is successful in fooling the buyer, the latter, discovering that he has been deceived, not only refuses ever after to purchase goods coming from the same shipper, but relates the story to his fellows—the story usually growing as it travels—until it not infrequently happens that the shipper's goods are practically boycotted, even the most fancy stock being neglected because it bears the shipper's name, trade-mark, or number.

On the other hand, painstaking care and patience will generally result in building up for the shipper an enviable reputation, securing for his shipments the top, sometimes a little above the top, of the market, because of their known unvarying good quality. When a producer desires to build up such a reputation, it will pay him to adopt a brand, as, for instance, " The Star " having first ascertained from his commission merchant that his brand will not interfere with any other on the market. He should then make it a rule, from which there must never be any deviation, to use it only on his choicest products, omitting the brand and using only his regular number on any shipment that can not be rated "strictly fancy." Such discrimination against the poor qualities of one's own product requires strength of character and firmness of purpose, but such a policy steadfastly pursued will result in a reputation for the goods bearing the adopted brand which will never fail to obtain for them the very top of the market.

PACKING.

Packing is, after the quality of the produce, the next most important consideration. A little study of the route your produce must take to reach the consumer will convince you of this. A typical trip will be as follows: Several miles ride in a spring wagon from farm to railroad, over a more or less rough road; then 10 to 500, or even 1,000, miles on the railroad; careless, hurried handling by trainmen loading the produce on the wagon of the commission merchant, and hauling over rough city pavements to his store; exposure for some time and another haul to the store of the retailer, where it is again exposed for sale, and usually another haul at lively speed to the home of the consumer. Consider what this means to tender fruit or vegetables, and the necessity of extreme care becomes obvious.—*Farmer's Bulletin No. 62.*

A WORD TO OUR FARMERS.

The annual report is a little delayed this year owing to my absence for several months abroad, engaged in immigration work, and also on account of the greatly increased work in the Department. These annual reports should be filed for future reference, as often letters are sent in for information that is given in the reports more fully than can be done by letter. I am still receiving parcels of minerals, etc., without the name and the post-office of the sender, and sometimes letters without post-office or signature. Of course, I am unable to answer them. I am always glad to hear from my fellow-farmers and to serve them in any way that I possibly can.

G. W. KOINER,
Commissioner.

BULLETIN No. 5.

REPORT OF THE TEST FARM

OF THE

DEPARTMENT OF AGRICULTURE

LOCATED AT SAXE, CHARLOTTE COUNTY, VA.

UNDER THE CONTROL OF THE

BOARD OF AGRICULTURE AND IMMIGRATION

SEASON 1906

S. H. HAMLETT, MANAGER

TEST FARM COMMITTEE:

J. M. BARKER, Chairman.	W. H. EGGBORN.
J. THOMAS GOODE.	G. W. KOINER.

FIFTH REPORT OF THE TEST FARM
OF THE
Department of Agriculture
SEASON 1906

BY E. W. MAGRUDER, CHIEF CHEMIST.
S. H. HAMLETT, MANAGER.

On January 1, 1906, Prof. S. B. Heiger, who had been Manager of the Test Farm since its beginning, severed his connection with the farm, and Mr. S. H. Hamlett was made Manager.

At that time the Board of Agriculture decided to make some decided changes in the management of the farm and in the manner of conducting the tests. Consequently, this year has been a transition period, and the time has been largely spent in getting everything in readiness for another year, therefore there are fewer results of crop tests to be given this year than usual.

WHEAT.

There were eighteen plats of wheat, each with a different fertilizer, but just after it was cut, and before it could be hauled up, some bundles were stolen from various ones of the plats, which ruined the value of the test, consequently no results are reported.

CORN.

As in many of the Western States, the yield and quality of the corn has been very greatly improved by careful and judicious seed selection, it was decided to start corn breeding this year and endeavor by proper selection to produce a thoroughbred corn which will yield better than any now grown in this section.

Consequently Virginia White Dent Corn was selected as the variety with which to start. The seed was gotten from T. W. Wood & Sons, and it was thought that a pure variety was obtained, but when the crop was harvested it seemed as if that was not the case.

This corn was planted on a hill a quarter of a mile from any other corn, next to the dark tobacco plats, so that it could not become mixed. Owing to unavoidable causes the corn was not planted till June 5th. It came up well and grew off nicely, the stand being perfect.

When it began to tassel (August 8th), every other row was detasselled to prevent those stalks from polinizing their own ears. That is, prevent in-breeding. Some of the most indifferent stalks in the other rows were also detasselled, so that the ears could only receive pollen from good stalks. Seed was selected only from the detasselled rows.

When the corn was ready to cut, September 26th, it was gone over and 159 of the most desirable stalks from the detasselled rows were selected. These stalks were selected for the size of the ear or ears, the height of the ears from the ground and the general good appearance of the stalks. Stalks which eared height up were avoided.

Each stalk was numbered, and the height of the stalk and the height of the ear above the ground measured and recorded. These stalks were then cut and put to themselves. When the corn had well dried out, it was shucked and the ear or ears from each stalk kept separate and numbered as the stalk. These ears were then weighed, and their length and diameter measured. They were then shelled and the cob weighed, thus giving by difference the weight of the grain. The diameter of the cob was measured and the length of the grain. The general appearance of the ear was noted with especial reference to the butt and tip, to see how well they were filled out. Thus a complete record of each stalk and ear was kept. From this data the best ears are selected for the seed corn of next year.

The grain from these selected ears will be planted in a plat separated from all other corn, and each ear will be planted in a row to itself, so that a record of the producing power of each may be kept.

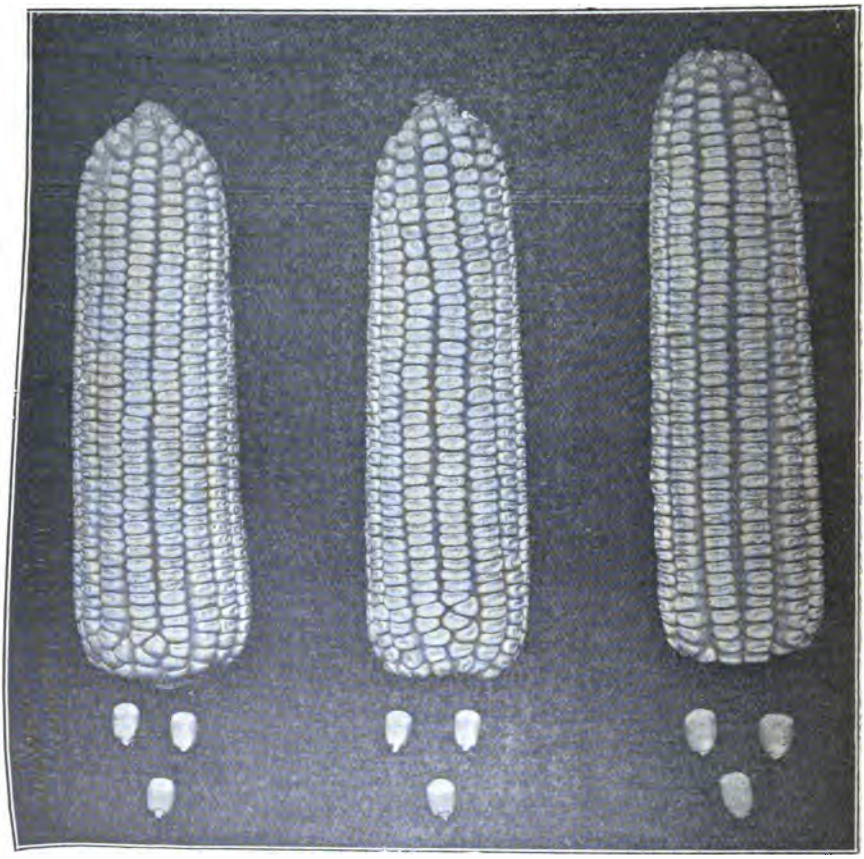
Alternate halves of each row will be detasselled, and all inferior or undesirable stalks will be detasselled, and seed for the following year will be selected from the detasselled half of each row. At harvesting time the stalks will be selected and the ears subjected to the same scrutiny as this year. By thus selecting only the best for seed it is expected that in time a superior corn will be produced, which can then be distributed to the farmers for seed.

TYPE OF CORN.

The type of corn aimed at and the principles governing the selection are the following:

First. A stout stalk of medium height bearing one or two good ears at a moderate distance above the ground. This will give stability to the stalk and enable it to stand erect, and not be blown over. It also makes the gathering easier.

Second. A ear of good length and thickness with very gentle taper towards the tip. The rows of grains should be straight and regular and the butt and tip well filled. The rows should be close together and the grains close on the ear, thus giving the greatest number of grains to the cob.



Seed Corn.

Third. The grain should be long and wedge-shape and well filled to the end, thus enabling more grains to be attached to the cob and leave less waste space on the ear.

Fourth. The cob should be of medium size, straight and the color of the corn. It should not be too small, as it is then more liable to break, and will not be able to hold so many grains.

The accompanying picture shows some of the best ears selected for seed this year, with a few grains from each ear laid flat in order to show the shape. These illustrate the type of corn it is desired to produce, but they are not ideal, and it is expected that better will be produced hereafter as a result of breeding.

TOBACCO.

BRIGHT TOBACCO.

The tests on bright tobacco were confined to test of different kinds of fertilizer on each plat.

The field in the northeast end of the farm was divided into nineteen one-tenth acre plats, 40 feet wide and 108.9 feet long. The land is a sandy loam, light in color and texture, and very easily worked. It was in bright tobacco last year. The land is not the best type of bright tobacco soil, but is fairly good and brings good bright tobacco, but will never bring the highest grade. The center of the plat is the highest part, and the land slopes from it in all directions, gently towards the east, but more rapidly towards the northwest, and although the plats were laid off as far as possible to prevent washing, there was some washing on the steeper plats, but not enough to effect the crop to any appreciable extent.

The first planting, June 2d, stood fairly well, but many hills had to be replanted, but quite a good stand was finally secured.

The variety of the tobacco used was the Wahn. The tobacco was well worked and properly topped and suckered, and it grew well. It was topped to eight to ten leaves, except in the case of the weaker plants, which were topped lower.

Owing to the excessively wet summer, and especially the wet August, the tobacco specked badly, as did the dark tobacco, and as did practically all of the tobacco in that neighborhood. This specking injured the value of the tobacco very greatly.

The first cutting was made on September 3d, and the rest cut on September 10th. All was flue-cured. Owing to lack of barn space the light and heavy-weight tobacco had to be cured together, so that none was cured as well as it should have been.

PLAN OF FERTILIZER TEST FOR TOBACCO.

The basis of the fertilization is a normal application of 800 pounds per acre of a fertilizer containing

Phosphoric acid, ...10 per cent., giving per acre 80 lbs.
Ammonia, ... 4 per cent., giving per acre 32 lbs.
Potash, ... 6 per cent., giving per acre 48 lbs.

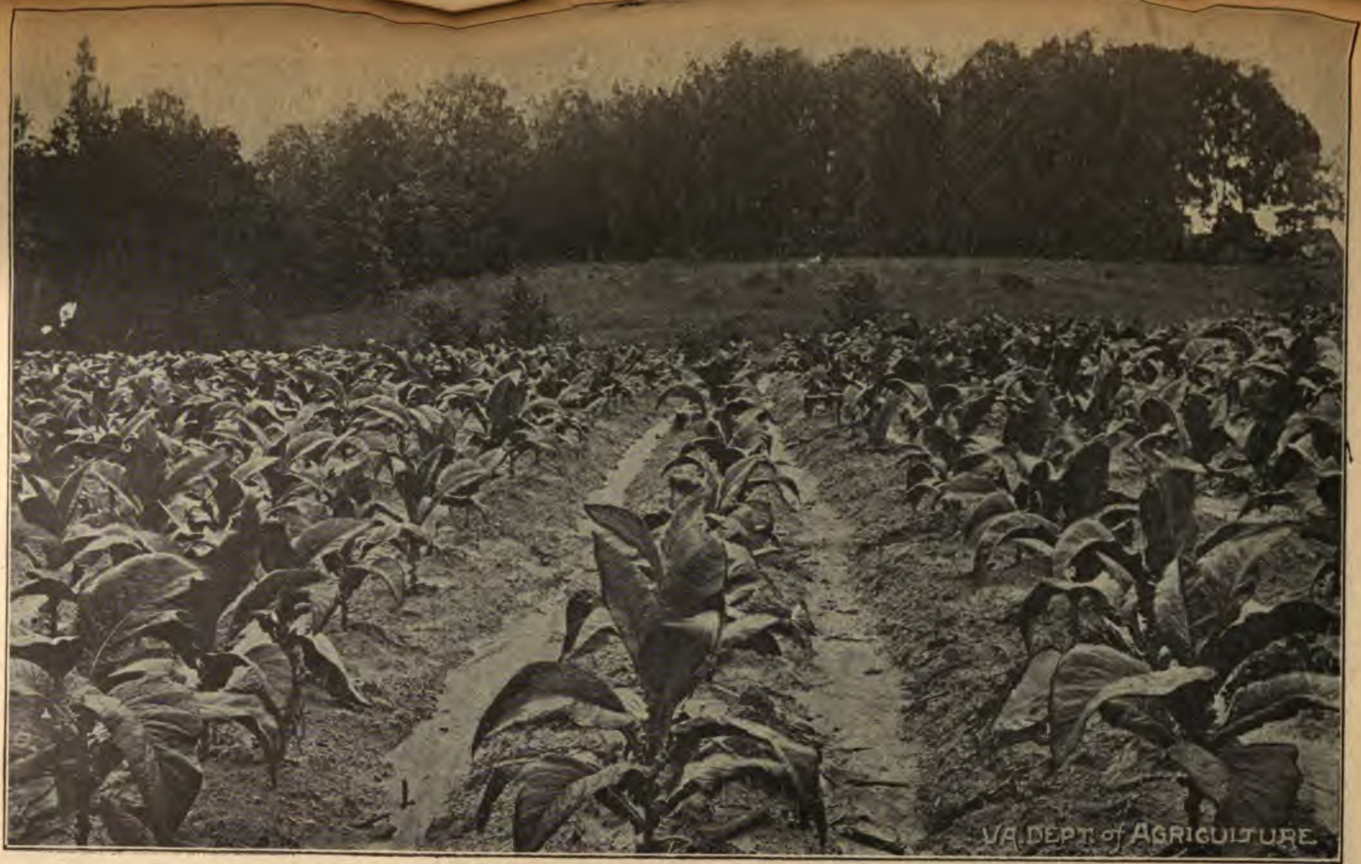
Which, therefore, will give on a tenth of an acre:

Phosphoric acid, ... 8 lbs. equals P.
Ammonia, ...3.2 lbs. equals N.
Potash, ...4.8 lbs. equals K.

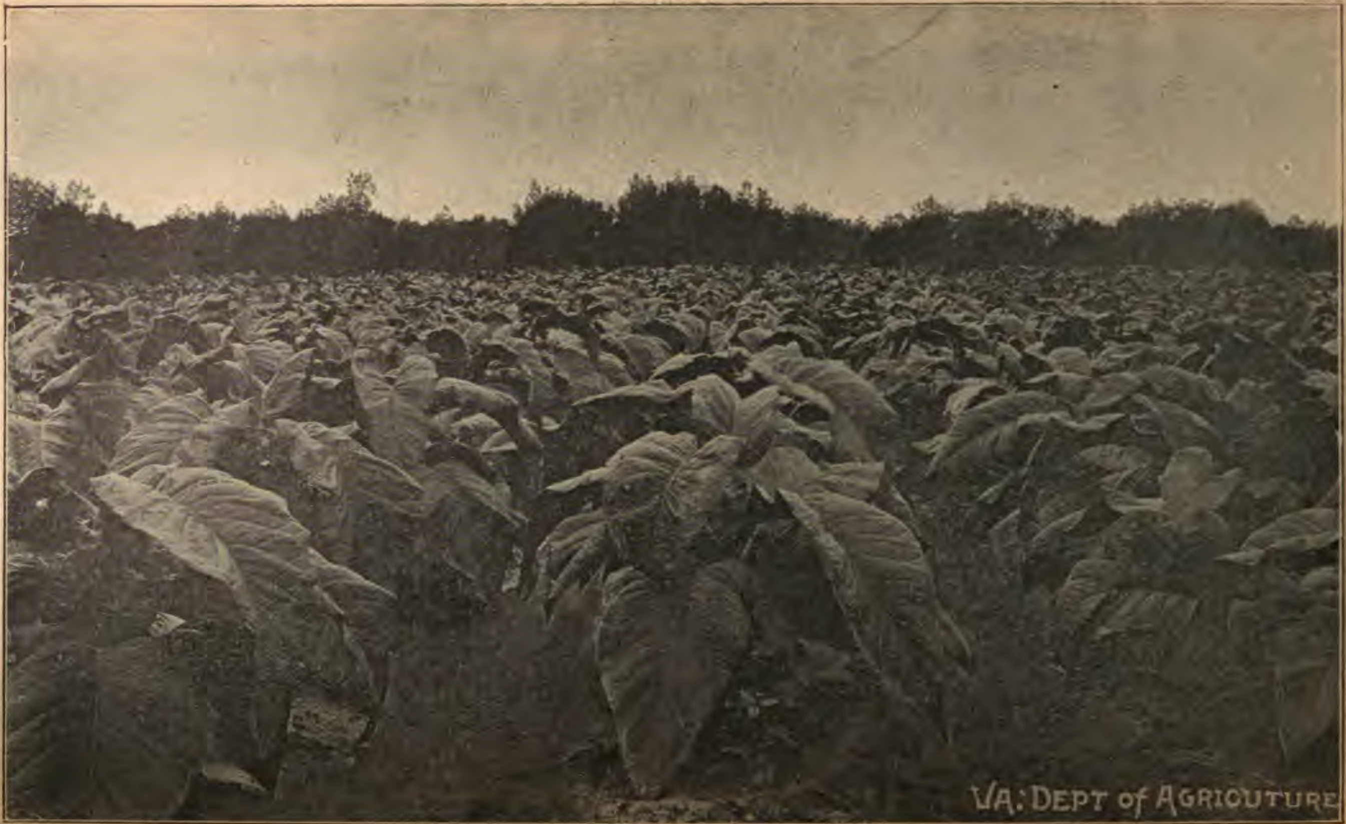
P is supplied by 50 pounds, 16 per cent. acid phosphate.
N is supplied by 18.8 pounds, 17 per cent. blood.
N is supplied by 16.84 pounds, 19 per cent. nitrate of soda.
N is supplied by 14.6 pounds blood, plus 3.8 pounds nitrate of soda.
K is supplied by 9.6 pounds, 50 per cent. sulphate of potash.
L is supplied by 400 pounds lime.

The different plats had the following application:

No. 1—P, 50 pounds acid phosphate.
No. 2—N, 18.8 pounds of blood.
No. 3—1,500 pounds stable manure.
No. 4—N, 16.84 pounds nitrate of soda.
No. 5—K, 9.6 pounds sulphate of potash.
No. 6—Blank.
No. 7—P N, 50 pounds acid phosphate, 14.6 pounds blood, 3.8 pounds nitrate of soda.
No. 8—P K, 50 pounds acid phosphate, 9.6 sulphate of potash.
No. 9—N K, 14.6 pounds blood, 3.8 nitrate of soda, 9.6 pounds sulphate of potash.
No. 10—P N K, 50 pounds acid phosphate, 14.6 pounds blood, 3.8 pounds nitrate of soda, 9.6 pounds sulphate of potash.
No. 11—Blank.
No. 12—½ (P N K), 25 pounds acid phosphate, 7.3 pounds blood, 1.9 pounds nitrate of soda, 4.8 pounds sulphate of potash.
No. 13—P_2 N K, 100 pounds acid phosphate, 14.6 pounds blood, 3.8 pounds nitrate of soda, 9.6 pounds sulphate of potash.
No. 14—P N_2 K, 50 pounds acid phosphate, 29.2 pounds blood, 7.6 pounds nitrate soda, 9.6 pounds sulphate of potash.
No. 15—3,000 pounds manure.
No. 16—P N K_{21}, 15 pounds acid phosphate, 14.6 pounds blood, 3.8 pounds nitrate of soda, 19.2 pounds sulphate of potash.

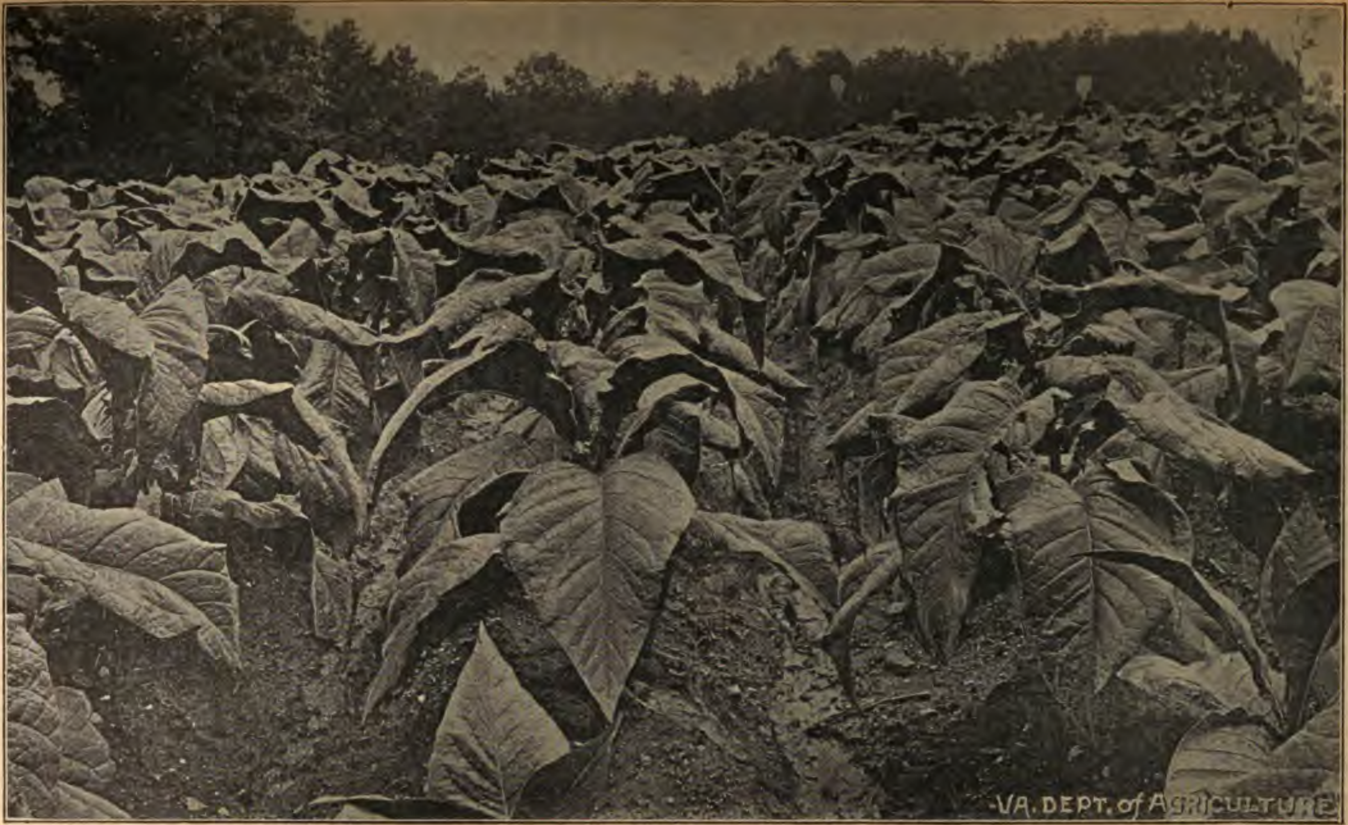


BRIGHT TOBACCO.
Plot No. 18. No Fertilizer.—*August* 18, 1906.



BRIGHT TOBACCO.

Plot No. 3. Manured at the rate of 15,000 lbs. per acre.—*August* 18, 1906.



BRIGHT TOBACCO.

Plot No 17. Fertilized with 2 (P. N. K.), that is at rate of 1600 lbs. per acre of a Fertilizer containing 10 per cent. Phosphoric Acid, 4 per cent. Ammonia, and 6 per cent. Potash.—*August* 18, 1906.

No. 17—2 (P N K), 100 pounds acid phosphate, 29.2 pounds blood, 7.6 pounds nitrate of soda, 19.2 pounds sulphate of potash.

No. 18—Blank.

No. 19—P N K L, 50 pounds acid phosphate, 14.6 pounds blood, 3.8 pounds nitrate of soda, 9.6 pounds sulphate of potash, 400 pounds lime.

It will be observed by a study of the plan of fertilization that the different fertilizer ingredients were tested alone, two together, all three together, and all three with lime, using in each case the amount of each material which would have been applied if a complete normal fertilizer had been used. That half the normal, double the normal amount of each ingredient was applied with the normal amount of the other two ingredients, and that double the normal of all three together was applied. Two plats with manure, one with double as much as the other, was also planted. There were three plats without any fertilizer, in order to compare the effects of the different fertilizers with no fertilizer. On the 18th of August the difference in the appearance of the different plats was very marked, as may be seen by the three accompanying pictures taken on that date; one with no fertilizer, one with a heavy application of manure, and the other with a complete fertilizer applied at the rate of 1,600 pounds to the acre.

On that date the no fertilizer plats and the one with potash alone were the poorest. The plats with phosphoric acid alone and ammonia alone had about the same growth of plants, but the ammonia plat was much darker green. When two ingredients were used, the growth was about the same, but when there was ammonia the color was much darker green. The plats which had manure (Nos. 3 and 14), the heaviest application of fertilizer (No. 17), the normal application of fertilizer with lime (No. 19), and the normal application of phosphoric acid and potash with double the normal amount of ammonia (No. 14) were the best and heaviest. Plats No. 3, with manure, and No. 17, with heavy application of fertilizer, appeared to be a shade better than any of the others. It was impossible to tell which was the best of the two.

Ammonia had a very marked effect in giving very dark color, and it also aided the growth, and probably produced more effect than either of the other ingredients. Potash had decidedly less effect than either of the other ingredients. This tobacco could not be gotten into condition to weigh and sell in order to give the results in this report.

DARK TOBACCO.

The tests on dark tobacco was also confined to tests of different kinds of fertilizer. The hill on the southern side of the place was selected for the tests, and five plats of one-fifth of an acre each were laid off, 40 feet wide and 217.8 feet long.

The land is a red clay with considerable sand, which gets very heavy in wet weather; but, if cultivated at the proper time, can be gotten into excellent condition. The land is gently sloping, and is very good dark tobacco soil. It was in clover last year. The land was in excellent condition when planted. The plats were planted June 6th, and stood quite well; after replanting the stand was very good. The variety used was the Lizzardtail.

The tobacco was well worked, and properly topped and suckered. It was topped to six to eight leaves, and grew well.

Owing to the excessively wet summer, and especially the wet August, the tobacco specked very badly, as did the bright tobacco; and as did practically all of the tobacco in that neighborhood. This specking injured the quality of the tobacco very greatly.

It was cut on September 14th and put in a barn and cured.

PLAN OF FERTILIZER TEST FOR DARK TOBACCO.

The plan of fertilizer tests for dark tobacco was the same as that for bright tobacco as far as it went, the basis being the application of 800 pounds per acre of a fertilizer containing

Phosphoric acid, 10 per cent.; ammonia, 4 per cent., and potash, 6 per cent.

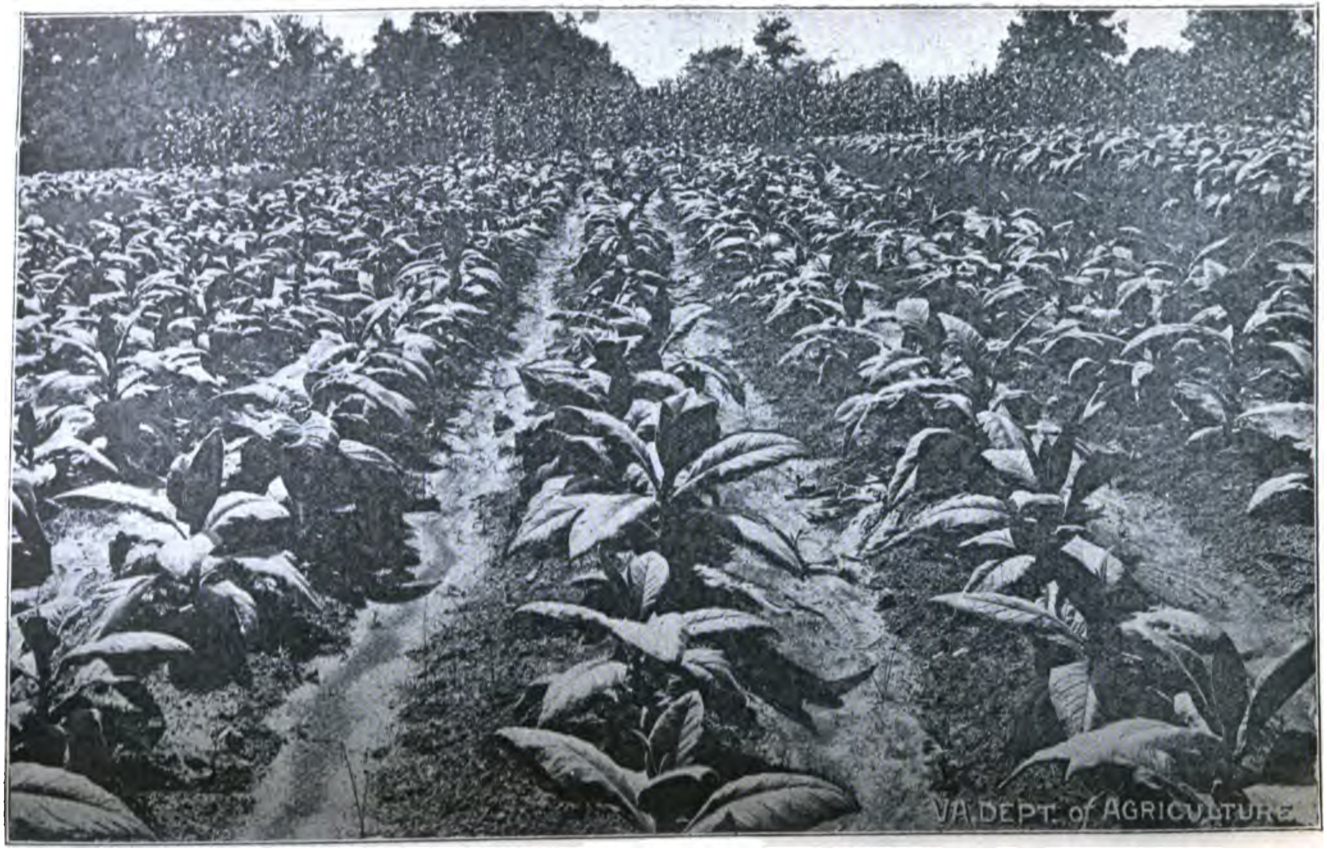
The different plats had the following applications:

No. 101—P, 100 pounds acid phosphate.
No. 102—½ (P N K), 50 pounds acid phosphate, 14.6 pounds blood, 3.8 pounds nitrate of soda, 9.6 pounds sulphate of potash.
No. 103—Blank.
No. 104—P N K, 100 pounds acid phosphate, 29.2 pounds blood, 7.6 pounds nitrate of soda, 19.2 pounds sulphate of potash.
No. 105—2 (P N K), 200 pounds acid phosphate, 58.4 pounds blood, 15.2 pounds nitrate of soda, 38.4 pounds sulphate of potash.

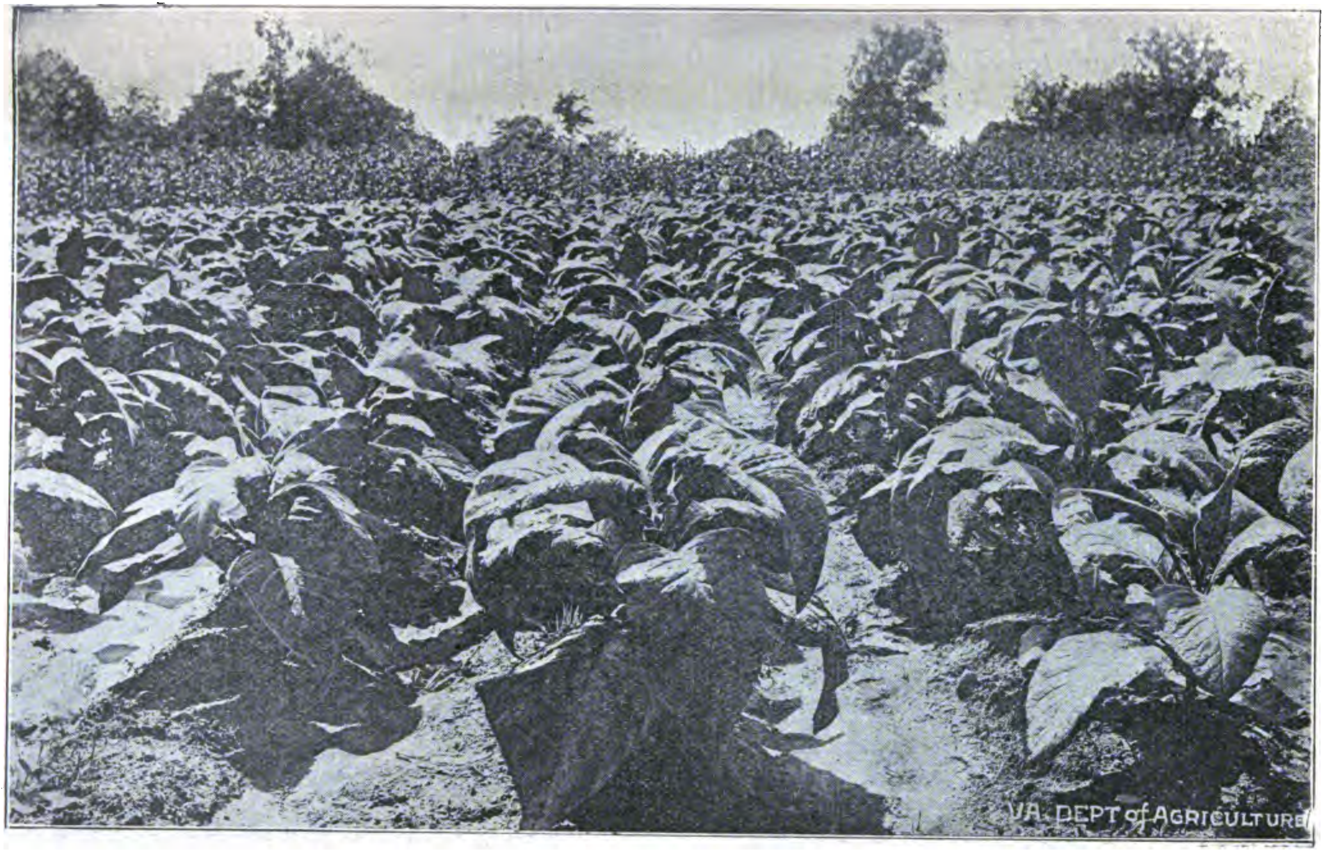
On August 18th the accompanying pictures of plat No. 103 with no fertilizer, plat No. 104 with the normal application of fertilizer, and plat No. 105 with double the normal application of fertilizer were taken.

The difference in the appearance was very marked between plat No. 103 with no fertilizer and all of the other plats.

Plat No. 105 with the double normal application was the heaviest and best, but appeared to be only a little ahead of No. 101, which had acid



DARK TOBACCO.
Plot No. 103. No Fertilizer.



DARK TOBACCO.

Plot No. 104, fertilized with P. N K., that is at rate of 800 lbs. per acre of a Fertilizer containing 10 per cent. Phosphoric Acid 4 per cent. Ammonia, and 6 per cent. Potash.—*August* 18, 1906, phosphate only. No. 101 appeared to be better than either No. 102 or 104. The land, however, of No. 101 was somewhat better than of the other plats. All of the fertilized plats were very good.

SELECTION OF TOBACCO SEED.

It has been found that tobacco can be very much improved by proper seed selection, and that, unlike corn and many other plants, it should be in-bred, as it were. That is, that each plant should polinized its own blooms, and should have no polin from any other blooms. This self-polinization is accomplished by tying a good paper bag over the seed head just before the blooms begin to open, and allowing it to remain until the blooming is all over, and there is no danger of any polinization from another plant. Before the bag is put on the head should be trimmed and thinned, so as not to leave too many buds. As the head grows and opens the bag should be slipped up on the stalk to allow more room for the head. It should also be occasionally opened and emptied of the fallen petals and then replaced. When all of the petals have fallen, it should be taken off, and the inferior or damaged seed pods removed; and if too many seed pods are present, some should be removed. It is important to have only comparatively few seed pods, so that all of the strength will go into them, and thus produce plump, heavy seed, for a good seed produces a much more vigorous and healthy tobacco plant than a small or defective one.

It was determined that a start would be made in the selection of tobacco seed, and thus endeavor to improve the variety. In order to accomplish the best results the co-operation of the Bureau of Plant Industry of the United States Department of Agriculture was secured. That Bureau sent Dr. J. W. S. Duvel down last summer, and he not only selected and bagged seed plants on the Test Farm, but also saw several of the adjoining farmers and secured their co-operation, and selected and bagged many seed plants on their places. He gathered these heads when ripe and took them to Washington, where he will subject them to a cleaning process, by which all of the defective, small or light-weight seed will be removed. These seed will be given to the farmers who grew them to test in comparison with seed saved in the ordinary way, and will also be given to some other farmers to test. The Test Farm will conduct tests with them. It is expected that the Bureau of Plant Industry will continue this seed selection and tests with the seed selected for several years.

TABLE OF RESULTS. SHOWING EFFECT OF FERTILIZER ON DARK TOBACCO.

The following table gives the results of the Fertilizer tests on Dark Tobacco. The missing hills were counted and an allowance made for them in the table, so that the table is made out as though there were no missing hills. The tobacco was graded and weighed and sold on the warehouse floor at Drake's Branch, and the prices stated are the ones actually paid. Plat No. 105 was lost in handling, so that it cannot figure in the test.

The table shows very conclusively that the application of Fertilizer was very profitable, and that the larger applications were more profitable than the smaller.

Plat No.	Kind and Amount of Fertilizer.	Grade No. 1.			Grade No. 2.			Grade No. 3.			Grade No. 4.			Total weight per plat, lbs.	Amount received per plat.	Amount per acre, lbs.	Amount per acre.	Cost of Fertilizer, per acre.	Gain per acre over no Fertilizer, lbs.	Gain per acre over no Fertilizer.	Profit per acre over no Fertilizer.
		Pounds.	Price per lb., cents.	Value.	Pounds.	Price per lb., cents.	Value.	Pounds.	Price per lb., cents.	Value.	Pounds.	Price per lb., cents.	Value.								
101	100 pounds Acid Phosphate....	30	11	$3.30	22	8	$1.76	32	7	$2.24	71	5.2	$3.69	155	$10.99	775	$54.95	$3.15	255	$16.80	$13.65
102	50 pounds Acid Pholphate.... 14.6 pounds Blood. 3.8 pounds Nitrate of Soda. 9.6 pounds Sulf. of Potash.	37	11	4.07	27	7.75	2.09	29	6.6	1.91	83	6.1	5.06	176	13.13	880	65.65	5.30	360	27.50	22.20
103	No. Fertilizer....................	13	7.5	.98	13	7.25	.94	23	7	1.61	55	6	3.30	104	6.83	520	38.15	0	0	0	0
104	100 pounds Acid Phosphate.... 29.2 pounds Blood. 7.6 pounds Nitrate of Soda. 19.2 pounds Sulf. of Potash.	88	12	4.56	21	8	1.68	45	8	3.60	142	5 9	8.39	246	18.23	1230	91.16	10.60	710	53.01	42.41
105	200 pounds Acid Phosphate... 58.4 pounds Blood. 15.2 pounds Nitrate of Soda. 38.4 pounds Sulf. of Potash.	This plat was lost.				....	....	....	...	....	....	....	...	...	......	......	......	21.20			

ALFALFA.

The land which had been sown in alfalfa in 1902, and which had produced satisfactorily up to this year, but which had showed last year that it was weakening, was so weak this spring and so much crowded with grasses that it amounted to nothing, and was not worth cutting. It was, therefore, plowed up on July 10th, and later on the land gotten in good condition with the disk harrow. About an acre and a half of the land adjoining, which was in peas last year, was also plowed and ordered. The whole was gotten in excellent condition. On September 4th it was sown with alfalfa seed at the rate of twenty pounds to the acre, with the exception of about a quarter of an acre, which was not sown then, as the seed gave out. This was seeded on September 26th. The seed were gotten from T. W. Wood & Sons, and were inoculated by them. About five tons of manure was applied to the land which had not previously been in alfalfa, and 300 pounds acid phosphate per acre was applied to all.

The early sowing came up promptly and very thick, and grew off finely, and has looked splendidly all fall, and is now looking most excellently. Much of the old alfalfa which was plowed up has rerooted or come up from the old roots, which were cut off. The seed sown later came up splendidly, and has grown off quite well, but not near so well as the early sowing, and shows very markedly the disadvantage of late sowing. The late sown alfalfa had an extra top dressing of manure in order to help it catch uo with the other.

GRASSES.

It was decided to test different grasses to determine which would do best. Therefore a part of the hill on the south side of the farm near the dark tobacco plats was selected. This is red clay soil with some sand, which gets very heavy in wet weather, but if cultivated at the proper time can be gotten into excellent condition. It is gently rolling.

Beginning on the road at the southeast corner of the field the land was laid off into twelve one-tenth acre plats, 40 feet wide by 108.9 long. Last summer the land had a luxuriant crop of peas, which were plowed under, and the land gotten into excellent condition, but owing to the exceedingly wet fall the plats were not seeded till November 5th.

All the plats were fertilized alike with acid phosphate at the rate of 300 pounds per acre. The plats were sown in the following grasses with amount of grass seed stated:

Plat No. 201—Timothy, 1 pound.
Plat No. 202—Red Clover, 1 pound.
Plat No. 203—Alsike Clover, 1 pound.
Plat No. 204—Red Top, or Herdsgrass, 1 pound.
Plat No. 205—Meadow Oat Grass, 3 pounds.
Plat No. 206—Meadow Fescue, 3 pounds.
Plat No. 207—Orchard Grass, 3 pounds.
Plat No. 208—Italian Rye Grass, 3 pounds.
Plat No. 209—California Burr Clover, 1 pound.
Plat No. 210—Timothy, ½ pound.
Red clover, ½ pound.
Red Top, ½ pound.
Meadow Oat Grass, 1½ pounds.
Plat No. 211—Alsike Clover, ½ pound.
Red Top, ½ pound.
Meadow Fescue, 1½ pounds.
Orchard Grass, 1½ pounds.

These plats will be kept in these grasses for many years, and the yields of each grass accurately weighed. It can then be determined how each yields and how long it will last without reseeding; also how the different mixtures of grasses compare with those sown alone.

MISCELLANEOUS FARM WORK.

A fairly good crop of wheat was raised, which yielded 133 bushels. The quality of the wheat was excellent. An excellent crop of oats was grown. Enough hay of good quality was raised to last the stock through the winter. The corn crop was excellent, about 140 barrels being made.

Most of the hill land which had no other crops was put in peas, and a splendid crop was raised, which were plowed under and the land planted part in wheat and part in rye. Clover and herds grass were sown with the wheat. Some of the poorer places of the farm were sown in German clover on September 19th. It is looking well.

STOCK.

There are on the place six young cattle, four cows, one calf and a bull. The bull is a thoroughbred Red Poll, and is a fine animal. There is one thoroughbred Red Poll cow with a fine bull calf by her side.

There are seventeen sheep, a thoroughbred Dorset Horn buck, some thoroughbred Dorset ewes and some thoroughbred Rambouillets ewes. A cross of the Dorset on the Rambouillet is being tried.

There are eight thoroughbred Berkshire hogs.

Four mules constitute the work team.

BARN.

A very substantial, well-built and commodious combination barn eighty by fifty feet has just been completed.

PLANS FOR THE FUTURE EXPERIMENTAL WORK ON THE TEST FARM.

In conducting any experimental work the tests must be repeated many times before any conclusions of value can be drawn, and this is most emphatically true of all agricultural experiments. Under the best conditions there are always so many possibilities and contingences, so many causes to influence the results, that it is very hard to correctly interpret the results, even after they have been accumulated for years.

The most important factor in all agricultural experiments, and the one over which the experimenter has no control, is the weather. He can select the land, the character and location; he can direct the preparation and cultivation; he can select the crop and regulate the amount and character of the fertilizer, but the weather, which has a greater influence over the results than all the others combined, he cannot control in the slightest degree. There are other causes which interfere and seriously effect the accuracy of any given set of results, such as insect enemies, and fungus and other bacterial diseases, etc.

In order, therefore, to arrive at accurate results as to the effect of any one thing over which we do have control, such as fertilizer, manner of cultivation, different varieties of any one crop, etc., it is necessary to experiment for years most carefully in order to eliminate as far as possible the effects of the causes over which we have no control in order to get at the effects produced by the causes over which we do have control.

It should not be expected of any agricultural experimental work that any results of much value would be obtained in a few years. The most valuable agricultural experimental data which has ever been recorded is that obtained at the Rothamsted Experiment Station, in England, where the same experiments have been repeated now for over sixty years, and are still being repeated, as it has been found that not near all has been learned which can be learned by their repetition. That being the case, it is foolish to expect too much at first.

Many people have complained that the Test Farm and experiment stations in general have so many excuses to make why such and such tests did not do better, such as the frost injured the fruit or vegetable, the fly injured the wheat, the drought ruined the corn, the wet weather sprouted the wheat or spoiled the hay, the hail injured the tobacco, etc., etc. The next time you are inclined to make that criticism or hear some one else make it ask yourself if all of your crops made maximum yields. Ask yourself if your wheat, or your hay, or your corn, would not have done better *but* for this, that or the other cause. Ask your neighbors about their crops and observe if they do not tell you that this crop would have done finely *but*——; that if they admit that one crop did well, observe if they do not have some *buts* about the others.

There is rarely, if ever, a year in which all the conditions are just right to cause all of the crops to make the largest yields.

The honest agricultural experimenter is an observer, a learner, a recorder of facts, and later he endeavors to interpret the facts recorded. He has no hobby to ride or pet theory to prove or disprove; he endeavors to learn all he can, and to do so he must record all the facts which in any way effect the test. And are not the weather conditions facts, such as so many inches of rain, or the lack of rain, just as much as so many bushels of wheat, or the number of pounds of fertilizer applied to the tobacco; and do not the weather conditions effect the yield as much as anything else? He would be a poor experimenter indeed if he neglected tc record and state the weather conditions or any other cause which might effect the crop in any way.

In order to properly interpret the results of any experiment or series of experiments everthing which effects the results in any way must be taken into account and given their true weight as far as possible. That will be the policy at the Test Farm. All facts will be honestly and truthfully recorded. All causes which are known to affect the crops in any way will be closely observed and set down, and especial attention and care will be given to discover new or previously undiscovered causes which may affect the crops, in order that by a proper interpretation of all the facts to so apply the old causes or the newly discovered ones, over which we have control, in such a way as to overcome to as great an extent as possible the evil effects of the causes over which we have no control, or only partial control, so that a greater yield or better quality may be obtained. In accordance with the foregoing principles all experiments will be conducted.

The following are the principle lines of experimentation which are under way or will be undertaken:

WHEAT.

The tests with wheat will be to determine what is the best and most economical fertilizer for that crop. A rotation of crops will be tried in conjunction with these tests. There will be four or five series of about eighteen plats. Each plat will have a different combination of fertilizer applied with the wheat. Grass is to follow the wheat, corn the grass, and German clover and peas the grass, when wheat will again be sown. Fertilizer will only be applied with the wheat. By having enough series of plats there will be a different crop on each series every year. Each crop will be accurately measured or weighed, and the results will thus show which is the most economical fertilizer for the wheat and succeeding crops.

Wheat will also come in the rotation on the tobacco plats.

CORN.

Corn will come in the rotation on the wheat and tobacco plats as described under those crops.

Variety tests—About fifteen varieties of corn will be tested each year side by side, in order to determine which variety is the most profitable. Each variety will be tested for a sufficient number of years to thoroughly demonstrate its value, or lack of value, as the case may be. I would appreciate it if farmers who have an extra good variety of corn would communicate with me, as I would like some of their corn for testing.

Corn breeding—By proper selection of the corn in the field, and after it is shucked, it is expected that a superior corn will be developed. The methods pursued are described under the heading Corn, page 202.

TOBACCO.

Fertilizer tests—As in the case of wheat, different combinations of fertilizer will be tried on both bright and dark tobacco. There will be four series of nineteen plats for bright tobacco and four series of ten plats for dark tobacco. The different combinations of fertilizer will be applied to the different plats to determine which is the best for the tobacco. The tobacco will be followed with wheat, the wheat with grass, and the grass with corn, then tobacco again. There will thus be a different crop on each series each year. Fertilizer will only be applied to the tobacco.

Tobacco breeding—In conjunction with the Bureau of Plant Industry of the United States Department of Agriculture, tobacco breeding will be continued, and by proper selection and bagging it is expected that the tobacco will be much improved.

Diseases of tobacco—In conjunction with the same bureau, a study of the diseases of tobacco before it is cut, and while it is being cured, will be studied in order to endeavor to find remedies.

Varieties of tobacco—Different varieties of tobacco will be tested, and cigar tobaccos will be experimented with in order to determine whether they can be profitably grown.

ALFALFA.

Alfalfa will be experimented with in order to determine whether it can be profitably grown, and under what conditions. Different methods of fertilization will be tested on it in order to determine if it cannot be made to last for a number of years by that name. Practically no experiments have ever been tried to determine what are the best fertilizers for alfalfa, and whether by proper fertilization it cannot be made to grow better and last longer.

GRASS.

Different kinds of grasses alone and in combination will be tested in a series of plats in order to determine what is best for this section.

STOCK.

Red Poll cattle are being raised in order to determine their fitness for this section. They were selected as being the breed most likely to meet the needs and requirements of this section. Later on it is expected that some feeding tests with cattle can be conducted.

Dorset Horn sheep are being raised in order to determine whether it is profitable to raise sheep in this section. They were selected as being the breed most likely to meet the needs and requirements of this section.

Berkshire hogs are being raised to demonstrate the advantages of well-bred hogs.

OTHER EXPERIMENTS.

In the course of time as the present experiments and plans are gotten well in hand and are running smoothly, and as it becomes apparent what experiments are needed or what it is desirable to test, other tests and experiments will be conducted to the very limit of the funds at the disposal of the Farm.

ATTITUDE TOWARDS THE FARMERS.

The Test Farm is for the benefit of the farmers. Its soul aim and object is to benefit the farmers. For that purpose alone was it started and is maintained. It is the desire of the Department of Agriculture that the farmers will visit the farm, see what is going on, and learn what they can from the experiments. The manager will always be glad to explain anything they do not understand. It is not expected that all tests will be successful. If that were the case, it would be no use to experiment, as the farmers could then be told at once what was best. It is only by trial that the true facts can be learned. As much or more can be learned from the failures as from the successes, and the failures will always outnumber the successes.

All farmers are invited to visit the farm and make suggestions as to what they most desire tested, for it is the object of the farm to experiment in those lines that the most of the farmers desire. All honest suggestions will always be gladly received and most carefully considered, and acted upon as far as practicable.

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